JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. 33 JANUARY 15, 1943 No. 1

BOTANY.—Ceroxylon ferrugineum *André, the Salento waxpalm.*[1]

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The waxpalms (*Ceroxylon*)[2] grow in the Andean region of northwestern South America from Caracas in Venezuela to southern Peru, or possibly into Bolivia. In some areas waxpalms occur in such numbers that they dominate the landscape, forming forests of ivory columns, known as "palmares." These palms are extremely beautiful—the graceful pinnate leaves crown a usually tall, slender trunk, which is covered with wax. The resinous wax can be scraped from the trunk and fashioned into candles and matches. The leaves are used for thatch and the trunks for construction. The outer wood is very hard.

The genus is justly celebrated. Certain of the species are unique among living palms—they are the tallest, grow at the highest altitudes, and endure the coldest temperatures of any palms in the world.[3] The most renowned waxpalms, which were first made known by Alexander von Humboldt, are those of the Quindío region in the Central Cordillera of Colombia. *C. quindiuense* (Karst.) Wendl. (=*Klopstockia quindiuensis* Karst.) is the very tall (60 meters, or about 200 feet) species that grows on the eastern slope at elevations from 2,000 to 3,000 meters (nearly 10,000 feet) and endures temperatures just above freezing. The very different species on the western slope has apparently been without a botanical designation; a valid name for it, published with a brief description in 1879, has escaped the attention of botanists. It is the purpose of this paper to bring to light that the name *C. ferrugineum* André[4] applies unmistakably to this species and can refer to no other palm.

Although *Ceroxylon* was established in 1807,[5] founded upon a single species, *C. andicola* Humb. and Bonpl., the genus is even now not well understood botanically. It is stated that Humboldt found this palm in the most elevated part of the Andes (the Quindío region), which separates the valley of the Magdalena River from that of the Cauca; more specifically, "It is found between the snow-capped summits of Tolima, San Juan, and Quindío . . . between 1750 and 2825 meters." This is a roughly triangular area on the eastern slope of the Quindío Pass and must be considered as the type locality of *C. andicola*. The *Ceroxylon* described in such glowing terms by Humboldt himself in his *Vues des Cordillères*[6] is probably not the one figured in connection with the formal description of the species by Bonpland in 1807. In fact, Bonpland states on page 4 of *Plantes Equinoxiales* that "Humboldt drew this plant on the spot; but the size of the drawing being smaller than that of the fascicles which we are going to publish under the name of Plantes equinoxiales, we have been obliged to make a larger drawing from it: it is this which I present here. It was made by Monsieur Turpin, who combines the eminent knowledge of a botanist with the talent of a skillful artist." The species is

[1] Received October 9, 1942.

[2] The genera *Klopstockia* Karsten and *Beethovenia* Engel are at present referred to *Ceroxylon* Humb. & Bonpl.

[3] BOMHARD, MIRIAM L. *The waxpalms.* Smithsonian Inst. Ann. Rept. 1936: 303–324, 4 pls., 2 figs. 1937. Spanish translation: *Las palmeras de cera.* Bol. Soc. Geograf. Colombia 6(4): 250–273, 3 pls. 1940.

[4] ANDRÉ, ÉDOUARD. *L'Amérique équinoxiale (Colombie-Équateur-Pérou).* Le Tour du Monde 37(945): 101. Feb., 1879.

[5] HUMBOLDT, A., and BONPLAND, A. *Plantes équinoxiales* 1: 1–6, pls. 1a, 1b. Paris, 1807.

[6] HUMBOLDT, A. *Vues des Cordillères,* pp. 13–19, pl. 5. Paris, 1810.

characterized by a single spathe and violet-colored fruits; the inner perianth (corolla) consists of three separate petals. The habit figure shows a bulge in the trunk.

No palm answering to the description and illustration of the type species has ever again been encountered. It is true that vast regions where the genus abounds still remain to be explored. Although *C. andicola* has not yet been rediscovered in Colombia, the figure and description may one day prove to belong to a waxpalm of Ecuador, where species with a bulged trunk do exist.[7] As early as 1856,[8] Hermann Karsten, who described a new waxpalm genus, *Klopstockia*,[9] stated that he had been unsuccessful in locating Humboldt's *C. andicola* on the eastern side of the Quindío, nor had he seen any waxpalms that agreed with the description of the genus. In 1858,[10] therefore, he published *K. quindiuensis* (transferred to *Ceroxylon* by Wendland) for the waxpalms he found "in the Quindío at the foot of Tolima, altitude from 2200 to 2280 meters." All the palms he saw had tall straight trunks (not ventricose), there were several spathes as in other members of *Klopstockia*, the fruits were coral-red, and the corolla was partly united below.

Humboldt appears to have been somewhat in error concerning the altitudinal limits for palms on the eastern slope. It is known that he crossed the Quindío divide and was then forced to camp for several days because of rains, but there is no indication that he noted the different character of the waxpalms surrounding him then on the western slope.

In March, 1876, however, Édouard André, traversing the Quindío trail from east to west, that is, from Ibagué to Cartago, and following the exact route that Humboldt took in October, 1801, at once observed that a different species occurred on the western side. André headed a scientific expedition (mission) to Colombia, Ecuador, and Peru, having sailed from St. Nazaire on November 7, 1875. He returned to Europe at the end of September, 1876. His official report[11] enumerates his extensive collections of herbarium specimens, seeds, living plants, insects, minerals, and other specimens of scientific interest. His travel and exploration account was published in a series of articles, *L'Amérique équinoxiale*, which appeared intermittently in Le Tour du Monde, from 1877 to 1880. This weekly journal is well printed and excellently illustrated. It was devoted to accounts of travel and exploration.

The name *Ceroxylon ferrugineum* was first published by André, with a brief description (amounting to a contrast of this palm with that on the eastern slope which he continues to refer to *C. andicola*), in Le Tour du Monde, vol. 37, no. 945, p. 101, 1879. It might be well to quote at some length from page 101. André states:

> On the faith of Humboldt and other voyagers, I indicated in a study of *Cerozylon andicola** that the altitude where they grow is between 1750 and 2825 meters. I am today correcting these figures from my own observations. On the eastern slope of the Quindío, I have not encountered this tree before 2,000 meters altitude and I have followed it up to 3,000 meters. The most abundant "palmares" are situated in the vicinity of Las Cruces between the elevations of Toché and La Céja. In going towards Ibagué, one encounters the palm until near Mediacion. The zone where it abounds only extends 15 to 20 kilometers, as a bird flies, north and south from the mesa of Herveo to the massif of the Quindío. . . . I have vainly searched the oak forests (*Quercus Humboldti*) which the celebrated German traveler said accompanied the wax palm. The oaks, which scarcely go beyond 1800 meters and which I had already noted . . . belong to a

[7] *C. ventricosum* Burret is bulged and has grouped leaf segments. *C. utile* (Karst.) Wendl. was described by Karsten as having aggregate leaf segments but he made no mention of a ventricose trunk. It is of interest that Richard Spruce listed a palm in Ecuador as being *C. andicola* (*Notes of a botanist on the Amazon and Andes . . . during the years 1849–1864*, vol. 2: 268. 1908).

[8] KARSTEN, HERMANN. *Plantae Columbianae*. Linnaea 28: 251–255. 1856.

[9] KARSTEN, HERMANN. *Die Vegetationsorgane der Palmen*. Phys. Abh. Kongl. Akad. Wiss. Berlin, 1847: 73–235, pls. 1, 2. 1849. Also KARSTEN, Linnaea, 1856: 251.

[10] KARSTEN, HERMANN. *Florae Columbiae* 1: 1–2, pl. 1. Berlin, 1858.

* See *Illustration horticole*, 1874, p. 9, with figure.

[11] ANDRÉ ÉDOUARD, *in* Archives Missions Scientifiques 5 (sér. 3): 49–83. 1879. On p. 55 André reports that he sent specimens of the Quindío waxpalms to Paris; also that many points concerning Humboldt's *C. andicola* remain obscure and that he hopes he will be able to clarify them.

temperate, not a cold, country. These reasons make me believe that Humboldt has confused the true *Ceroxylon andicola*, that of Las Cruces, with another species, smaller, as yet little known (*C. ferrugineum*). It is characterized especially by the rough surface of its berries, and it abounds in the Andes, principally on the west of the Central Cordilleras and almost into the Republic of Ecuador.

After crossing the crest (3,485 meters), André observed that the vegetation was at first quite similar to the unimpressive high-altitude flora of the opposite side. Continuing his descent toward Salento and the Cauca valley, he remarks, on page 106: "But as soon as the barometer indicated 2800 meters altitude and large trees dominated, then giant oaks appeared, this time intermingled with the other species of wax palm of which I spoke previously, *Ceroxylon ferrugineum*." He states further, on page 108, that the waxpalms disappeared along his route on the western slope at 1,800 meters.

Baron von Thielmann, in *Vier Wege durch Amerika* (1879), says on page 374 that he arrived at the lower limit of the waxpalm at 1,750 meters, near the Río Quindío (western slope). His footnote to this remark is worth quoting:

> According to the statements of the latest plant explorer in this region, Ed. André, these wax palms at the western base of the Quindío were not identical with those of the eastern slope, but belonged to the related species, *Ceroxylon ferrugineum*. The wax palm of Humboldt in the narrow sense, *Ceroxylon andicola*, inhabits according to André only the eastern slope of the Cordillera between 2,000 and 3,000 meters.

Interestingly enough, the name *Ceroxylon ferrugineum* has appeared in botanical literature but not ascribed to André. This may be due to the fact that André's name was published in a journal devoted to travel. Indeed, this name has been variously listed as being of horticultural origin,[12] or credited to Regel,[13] to Wallis,[14] or to Linden.[15] The entry as a valid name given in *Index Kewensis* is as follows: "ferrugineum, *Regel, Gartenfl.* (1879) 163. t. 977.—N. Granat."

In this brief article (June, 1879) Regel makes known three palms that were collected by G. Wallis somewhere in tropical America. Regel states that the name *Ceroxylon ferrugineum* seems to have been given only provisionally by Wallis to this palm. There is no description. Figure 3 of plate 977 consists of three elements: a habit sketch of some feather-leaved palm (there are no spathes, nor is it discernible whether the pendant inflorescences are in fruit or in flower), a fruit with burst pericarp, and a seed showing the micropyle. The fruit and seed may possibly belong to some *Ceroxylon;* the habit sketch is unidentifiable. Dr. Max Burret[16] is eminently correct in consigning this name to "nomina delenda"; that is, insofar as Regel's *Gartenflora* is concerned. But this is not the first date of

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[12] KERCHOVE (DE DENTERGHEM), OSWALD. *Les palmiers.* Paris, 1878. On p. 238 of the Index Général, Ceroxylon ferugineum (sic) Hort., is listed as an invalid name, being in boldface type which he uses to indicate invalid species. The origin of *C. ferrugineum* as a horticultural name, and this appears to be the earliest printing of it, can only be surmised. André was himself especially interested in ornamentals. He returned from South America in 1876 and had sent large quantities of palm and other seeds, living plants, etc., to J. Linden's horticultural establishment in Ghent, as mentioned on p. 70 in his official report (Archives Missions Scientifiques, 1879). There was ample time for the name to be known among horticulturists between André's return and his publication of it. If it did not originate with him—and this seems unlikely—at least he is the first to have given characters to the different palm on the western slope of the Quindío.

Dr. Burret also cites the name as a horticultural one. See footnote 16 as well as footnote 14 (Dahlgren's *Index of American palms*).

[13] REGEL, EDUARD. *Gartenflora* **28**: 163–164, pl. 977, fig. 3. June, 1879.

[14] REGEL, EDUARD. *Op. cit.* 389. In the index the name appears as follows: "Ceroxylum (sic) ferrugineum Wallis 163." See also DAHLGREN, B. E., *Index of American palms.* Bot. Ser. Field Mus. Nat. Hist. **14**: 86. 1936. The entry on this page as an invalid name is "*ferrugineum* Hort. Wallis, Regel Gartenfl. . . . nomen . . . "

[15] LINDEN, J. *Plantes introduits et mises pour la première fois dans le commerce par l'établissement J. Linden.* Illus. Hort. **28** (sér. 4, no. 1): 15–16. 1881. It has previously been mentioned that André sent some of his South American material to J. Linden for introduction. The entry on p. 16 of Linden's palm list reads, under *Ceroxylon:* "ferrugineum, Lind., Colombie."

[16] BURRET, M. *Die Gattung* Ceroxylon *Humb. et Bonpl.* Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem **10** (98): 853. 1929. The name is listed under the heading "Species nimis imperfecte notae vel nomina delenda" as follows: "*Ceroxylon ferrugineum* Hort. in Regel Gartenflora XXVIII (1879) 163, tab. 977, fig. 3." He suggests that the species be looked upon as a "Species delenda."

publication of *C. ferrugineum*. Inasmuch as vol. 37 (the first semester of 1879) of Le Tour du Monde begins with no. 939, there seems to be little question that no. 945 appeared in the third week of February, 1879. (The even earlier horticultural nomen in Kerchove may be disregarded. See footnote 12.)

André collected herbarium specimens of 4,300 species, with one to ten duplicates for each number.[17] His herbarium collection numbers reached 3,175 by the time he arrived at Pasto (this includes his trip over the Quindío). Two waxpalm specimens collected by André (nos. 2426 and 2563) are deposited in the herbarium of the New York Botanical Garden. The labels bear the designation, "*Mission scientifique de* Ed. ANDRÉ. HERBARIUM AMERICAE AEQUINOCTIALIS." Specimen no. 2426 was collected on March 9, 1876, between Las Cruces and Quindío, that is, on the eastern slope. It consists of portions of two glabrous spadices, one with some male flowers. The date of collection for specimen no. 2563 is March, 1876; the locality, "Quindío-Salento-Tambores." Tambores does not appear on recent maps of the area, but it is clearly indicated on André's map no. 5 (his route from Quindío to Cartago, thence south to Buga) about two-thirds of the distance from Salento toward Cartago.[18] This specimen consists of the upper portion of a fruiting spadix to which, unfortunately, no fruits are attached. The axis and branches are clothed with a rusty-brown scurf—the obvious ferruginous character on which André based his very appropriate name, *ferrugineum*.[19] Fig. 1, *F*, shows a small branch of André's specimen.

[17] ANDRÉ ÉDOUARD, *in* Archives Missions Scientifiques, 1879, p. 69.

[18] ANDRÉ, ÉDOUARD. Le Tour du Monde 37: (945): 99. 1879.

[19] Examination of this and later collections of *C. ferrugineum* shows that this covering is rather remarkable in character. Although the spadix appears at first glance to be clothed with rusty tomentum, it is clear under a lens that there are no trichomes. The scurf that clings to the surface appears to have been developed from numerous papillae or crater-like projections which occur on the basic surface of the spadix axis. The scurf is not easily rubbed off with the fingers. It ignites quickly when touched off with a match and the odor emanating from it in burning is similar to that when the wax on the trunk is ignited.

It is likely that fruits accompany other specimens of *André 2563*. André mentions, on page 100 of vol. 37 (Le Tour du Monde), in connection with the felling of a tree of "*C. andicola*" (east slope of the Quindío), that the thousands of berries, some leaves, spathes, and trunk sections that he sent to Europe had become the property of the Muséum d'Histoire Naturelle in Paris. It is reasonable to suppose that adequate material of *C. ferrugineum* was also collected by him.

He specifically stated, however, that the fruits were characterized by their roughness, thus differing from those of the species on the eastern slope. Specimens of this smaller palm from the western slope of the Quindío, collected by E. P. Killip, of the Smithsonian Institution, and Dr. T. E. Hazen, of Columbia University, in 1922, have berries whose surface is roughened by small pustules.[20] There are two sheets in the U. S. National Herbarium of *Killip 9049*, collected July 25–31, 1922, near Salento in the Department of Caldas, between 1,700 and 1,900 meters altitude. One consists of an upper section of a leaf; the other, of a portion of fruiting spadix, with the fruits in an attached pocket. A photograph of the palm is also affixed to the sheet. A single sheet of *Killip 9049* in the New York Botanical Garden consists of a similar leaf portion, section of spadix, and pocket of fruits. Two mounts comprise the U. S. National Herbarium specimen of *Hazen 10149*, collected August 25–28, 1922, in the Quindío valley, toward Río Boquío, between 1,600 and 1,700 meters. Part of a leaf is mounted on one sheet; a spadix section with several fruits attached and a pocket of fruits make up the other. The spadices of these specimens, with rather stout zigzag branches, are unmistakably ferruginous; the surface of the spherical fruits, buff-colored when dry is definitely pustulate or "pebbly." These specimens were collected in the same region as André no. 2563 and are undoubtedly *C. ferrugineum*.[21]

[20] BOMHARD, MIRIAM L. *Op. cit.*: 315.

[21] On the eastern slope of the Quindío, *Killip & Hazen 9525* was collected on August 2, 1922, between La Céja and Agua Bonita, at 2,500 to 3,100 meters altitude. This specimen consists of only a portion of a leaf; a photograph is also

The most recent, and at the same time the most complete, collection of the Salento waxpalm that I have seen was made by Dr. David Fairchild, July 11, 1941, on the extensive ranch of Dr. J. F. Galloway, at 1,828 meters. The ranch, on which there are hundreds of waxpalms, is situated on the Quindío River above Salento. *Killip 9049* was also collected on the Galloway place. Dr. Fairchild not only collected seeds for plant introduction but also made a special effort to secure herbarium material (*Fairchild 1023*). I have been privileged to examine parts of a leaf, an entire fruiting inflorescence with spathes, fruits, seeds, and sections of the trunk. In a letter to Dr. Walter T. Swingle, Dr. Fairchild wrote from Bogotá, July 14, 1941: "They are magnificent palms in a setting so beautiful that you want to stay there forever . . . I saw no palm that I thought was quite 200 feet. One that had fallen Dr. Galloway stepped off and it was only 43 paces long. It was a smallish example, I think. Dr. Galloway promised to measure one accurately and let me know. I shall be surprised if any go over 200 feet and most of them I wager will measure under that. This fact does not detract from their amazing beauty and the marvelous character of this organism, which can stand up perfectly straight in the winds of some considerable violence—60 km per hour would be a maximum I think—that blow down the pass."

A complete description of the Salento waxpalm can not form a part of this paper. Knowledge of the flowers is lacking, but arrangements made with Dr. Galloway should soon provide flowering material. Certain measurements are also lacking. There is need of an adequate description of the living trees.[22] A very general account of *Fairchild 1023*, which is not offered as a technical description, is given below.[23]

affixed. It is probably, from the locality at least, *C. quindiuense*. It is unfortunate that there are no fruits. The segments of this part of the leaf (probably taken from below the middle) are about 68 cm long and 4 cm wide. They are whitish-scaly on the under surface; the rachis is also whitish-scaly below and on the sides as well. The leaf is apparently much more robust than in *C. ferrugineum*.

Mr. Killip collected *Ceroxylon* specimens on March 27 and 28, 1939, along the new Quindío highway, between Cajamarca and the summit of the Divide (eastern slope), at 2,438 meters. The highway more or less parallels the old Quindío trail, which has now fallen into disuse, but runs 7 to 10 miles south of it. His specimen no. 34540 consists of part of a spadix, which appears to be glabrous but is actually faintly scurfy (puberulous where the scurf seems to have rubbed off), and fruits, which are deposited in the separate fruit collection of the U. S. National Herbarium. They were a reddish color when fresh but are gray when dry; superficially, they are quite smooth. It is almost surely *C. quindiuense*, or very closely related to that species. The seeds are black as in *C. quindiuense*. One of these fruits and a cross-section of the seed are shown in Fig. 1, *A* and *B*, for comparison with *C. ferrugineum*.

[22] To be fully understood botanically, palms are best studied by investigators who have frequent and ready access to them in their native habitat. Fortunately, Dr. Armando Dugand, director of the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia, with headquarters at Bogotá, has become interested in palms. Among several papers already published toward a comprehensive survey of the Colombian species, a preliminary list, *Palmas de Colombia*, appeared in Caldasia 1: 10–84, 1940. For *Ceroxylon*, see pp. 37–39 of this article.

[23] The following account is being given to serve as a partial record of *Fairchild 1023* (*C. ferrugineum*), since it seems worth while to set down any data that may add to the knowledge of a species. This specimen was collected close to the type locality of André. The trunk is at least 40, and not more than 60 meters tall. It measures about 30 cm in diameter toward the base, tapering gradually to 15 cm or less near the summit. The leafscars, which are waxy, do not completely encircle the trunk (see pl. 2, Smithsonian Inst. Ann. Rept. 1937). Five turns bring the ninth scar directly above the first. The vascular elements stand out on a section as stiff black bundles.

The reduplicate segments, with strong midrib, of the large pinnate leaves are placed uniseriately, without a pulvinus, at rather regular intervals on either side of the rachis. The segments toward the apex of the leaf, closely spaced, are nearly opposite, whereas those near the middle, at 2–2.5 cm intervals, are subopposite or alternate. (The lowest section of the "blade" of material I have examined apparently comes from a smaller leaf than the rest of the material. However, in it the 5 or 6 lowest segments are shorter, narrower, and grouped closely together at the base of the "blade.") The longest segments of the sections I have seen measure 75 cm; these are widest (about 3.5 cm) some distance above their point of insertion, tapering toward the apex, which is cleft. The relatively soft, lax segments are glabrous and green above; whitish-scaly beneath. The slender rachis is also glabrous (perhaps somewhat resinous) above; the lower face is similar to the under surface of the leaves in its whitish- or grayish-scaly indument; the sides are glabrous. A portion of the leaf, taken from the section where the segments are longest, shows the rachis, which is 2 cm wide at this point, to advantage. There is a shallow groove on the upper face; the lower is rounded-convex. A cross-section of the rachis is

It seems evident from his treatment of *Ceroxylon*[24] that the eminent palm specialist Dr. Max Burret is, unfortunately, aware neither of André's publication of *C. ferrugineum*, inasmuch as he gives only the Regel citation, nor of his herbarium specimens. It may be assumed that he believes *C. andicola* occupies the Quindío region from Ibagué all the way to Cartago. Furthermore, apparently owing to the fact that a *Ceroxylon* specimen collected by August Fendler, in Venezuela but with no other data,[25] came to his attention, Dr. Burret has added the ferruginous character to the spadices of *C. andicola*.[26] He has published the

rectangular or, better, vertebra-shaped, rather than triangular as in so many pinnate palm leaves. The sides of the rachis slant downwards at only a slight angle from the upper to the lower face. The margins of the upper and lower faces are somewhat extended in phlange-like fashion (probably slightly emphasized in the dry material); the insertion of the segments, therefore, appears to be partially concealed in the shallowly U-shaped sides of the rachis.

The paniculately branched fruiting spadix is about 24 dm long including the peduncle, which measures 15 dm. It is covered with ferruginous scurf throughout. The axis of the spadix is about 2.5 cm across at its base. There are about 75 primary branches including the smallest ones at the apex. These branches are comparatively stout; strongly thickened where they arise from the main axis. The longest, 20 cm above the base, measures 60 cm. The secondary branches have the zigzag, tendril-like appearance of other *Ceroxylon* specimens I have seen, but the undulations seem to be more angular. The short thick pedicels of the fruits are set at the undulation angles. (The flowers are, of course, solitary.) Fig. 1, *F*, showing a branch of *André 2563*, should make this clear.

I hesitate to describe the spathes, which, although still attached to the fruiting peduncle in this specimen, are already somewhat lax and spent owing to age, and furthermore, are so fragile that they shatter rather easily. Moreover, the character of the spathes can best be seen when a palm is in flower. The measurements here given are only approximate and provisional. Dr. Fairchild specifically mentioned that there were three spathes, covered with grayish pubescence. However, I find remnants of a fourth partial spathe or bract, which opens from the main axis 30 cm below the body of the spadix. Assuming that the peduncle of this specimen, which, like the spathes, is covered with rufous almost velvety scurf, was severed fairly close to the trunk, then the first spathe (15 dm long) comes from near the base; the second (about 18 dm in length) arises about 5 cm above the first; and the third (about 19 dm long) comes off 15 cm above the second, is 8 or 9 cm wide, and strongly folded near the tip.

According to Dr. Fairchild the fruits were "deep orange color" when fresh. They fade to a buff yellow on drying. These are 16 mm in diam. and 17 mm in height (Fig. 1, *C*). The position of the three stigma remains may be noted to one side of the base of the fruit, where the perianth persists. The outer, rather thin-leathery exocarp is roughened by pustules and is slightly speckled. (Fruits that are not entirely dried out are sublustrous because of the wax.) The fleshy mesocarp is rather friable; mucilaginous when placed in water. The papery, gray endocarp adheres lightly to the seed. The seeds (there is one in each fruit) average 12–12.5 mm in diameter and 13 mm or slightly more in height. They are chestnut-brown and have a roughish surface. The point of attachment is knoblike and the micropyle is prominent just to the side of the knob. The albumen is equable and the embryo subbasilar (Fig. 1, *D* and *E*).

[24] BURRET, M. Notizblatt 10(98), 1929. See the key, pp. 841–842; the discussion of *C. andicola*, pp. 842–844, and *C. quindiuense*, pp. 845–846, in which it is stated that *C. quindiuense* has been mainly mistaken for *C. andicola*.

[25] Thus far I have examined two *Ceroxylon* specimens bearing the label "PLANTAE VENEZUELANAE. Prope coloniam *Tovar* legit A. Fendler." That in the New York Botanical Garden is dated 1854–55; the other, in the herbarium of the Academy of Natural Sciences of Philadelphia, is dated 1856–57. There are no additional data. Three other specimens in the Gray Herbarium, all dated 1854–55, are undoubtedly of the same collection as that in New York. Although it is true that the spadices of all are ferruginous and the fruits rough, the latter are mainly twinned, smaller than those of *C. ferrugineum*, and the surface is much more uneven—verrucose with crater-like projections. Moreover, the sides of the rachis—and therefore the appearance of the insertion of the leaf segments—is quite unlike that of specimens of *C. ferrugineum*. From all accounts, it seems practically certain that Fendler did not travel in Colombia. Dr. H. W. Rickett, bibliographer of the New York Botanical Garden, wrote me in a letter of April 26, 1941, that Fendler took up residence in Colonia Tovar, a small colony 35 miles west of Caracas, Venezuela, in 1853. Except for the winter of 1855–56 spent in the United States, he seems to have been in the general region of Colonia Tovar, collecting many plant specimens, until 1858. No doubt, there are *Ceroxylon* species with ferruginous spadices and rough fruits which await investigation in parts of South America other than the western slope of the Quindío.

[26] BURRET, M. *Palmae neogeae*. Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem 11(105): 319–320. 1932. In this later note concerning *Cerozylon andicola*, Dr. Burret refers to his treatment of the genus in Notizblatt, 1929, and again mentions the Fendler specimen. He states that in the light of specimens *Killip 9049*, *Hazen 10149*, and *Killip & Hazen 9525*, which were sent him for determination, he is puzzled, especially since no. 9525, collected at the higher altitude, appears to be *C. quindiuense*, whereas those of the lower altitude seem to him to be *C. andicola*. He has determined no. 9525 as *C. quindiuense* with a question and adds that it is perhaps *C. andicola*. He determined the other two as *C. andicola*.

Dr. Burret himself previously pointed out

name *C. furfuraceum* with Latin description for the Fendler specimen but has placed it under his discussion of *C. andicola*. I can find no indication in Bonpland's description or figures that the spadices of this species are other than glabrous, nor is there any statement in the comparatively detailed description of the fruits that the surface is verrucose.

(1929) that *Triana 720*, with its male flowers, is doubtless *Klopstockia quindiuensis*. The Triana material is thought to have been collected with Karsten, who later described *K. quindiuensis*. I have examined *Triana 720* and *723*, collected between 1851–57. A section of leaf and a spadix branch (no. 720 has two branches mounted) make up these specimens. The male spadices are apparently glabrous (actually somewhat puberulous under a lens) and glaucous or waxy. The flowers agree perfectly with Karsten's fig. 4, plate 1, *Florae Columbiae;* the spadix also shows tertiary branching. Moreover, the male spadices of the Triana specimens are strikingly similar to the male spadix of *André 2426*, collected on the eastern slope, except that the latter, although glaucous, is not puberulous. Dr. Burret further states that it is impossible to imagine that male and female plants of the same species would differ in the very striking indument of the spadices. I might add that *Ceroxylon* is described by Bonpland as polygamo-monoecious, whereas Karsten's *Klopstockia* is dioecious, polygamo-dioecious, or monoecious.

It would be enlightening to know the character of the specimen in the Humboldt herbarium in Paris purported to be the type of *C. andicola*, but without exact locality. Although a clear photograph of it is in the U. S. National Herbarium, Mr. Killip's negative no. 365, the branches of the spadix section are so dense that I am unable to glean much concerning its character.

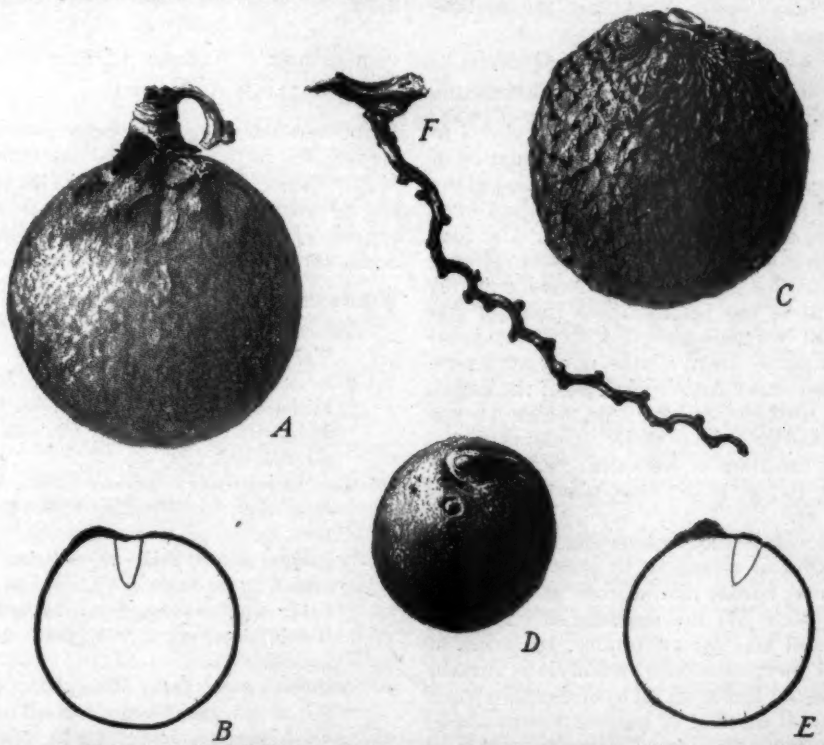

Fig. 1.—*A*, Glabrous fruit of *Killip 34540, Ceroxylon quindiuense* or near this species; collected on the new Quindío highway between Cajamarca and the summit of the Divide, at 2,438 meters. The position of the three persistent stigmas to one side of the base of the fruit is indicated. *B*, Longitudinal section of seed showing position of the embryo. *C*, Pustulate fruit of *C. ferrugineum, Killip 9049*. *D*, Outer view of a seed, showing the position of the micropyle in relation to the hilum. *C. ferrugineum, Fairchild 1023*. *E*, Longitudinal section of seed *D*, with position of embryo indicated. *F*, Branchlet of ferruginous spadix, *André 2563*. Drawn by Leta Hughey. (All ×2½ except *F*, which is natural size.)

Dr. Burret does cite André in L'Illustration Horticole, 1878, as to his observations concerning Humboldt's altitudinal data. This excerpt from the Le Tour du Monde articles, although quoted, is not quite identical with the statements that appeared in that journal in February, 1879, inasmuch as André withholds the name of the species on the western slope of the Quindío. This portion of the excerpt reads, "another species, smaller, as yet little known, of which I shall speak later."[27] Dr. Burret also cites Baron von Thielmann's *Vier Wege durch Amerika*, but appears to have overlooked André's name, mentioned in a footnote.

Recognition of André's publication establishes the botanical identity of the distinct species of waxpalm that occurs on the western slope of the Quindío, in the region of the town of Salento and of the rivers Boquío and Quindío. The full extent of its range is unknown. The elevations at which it grows may be placed, from available data, at 1,600 to 2,800 meters. The material thus far collected in the Salento area is quite uniform in character. André's brief description,[28] substantiated by his own and later collections, appears to be sufficiently adequate to validate the name *Ceroxylon ferrugineum* André.

[27] ANDRÉ, ÉDOUARD. *Les palmares de* Ceroxylon andicola *en Colombie.* Illust. Hort. **25**: 176. 1878.

[28] The description seems to meet the requirements of articles 36 and 37 of the International Rules.

BOTANY.—*New names in* Quercus *and* Osmanthus.[1] ELBERT L. LITTLE, JR., U. S. Forest Service. (Communicated by WILLIAM A. DAYTON.)

New names for four natural hybrids in *Quercus* and validation of a combination in *Osmanthus* are needed for the revision of the *Check list of the forest trees of the United States*, now nearing completion. The four names in use in *Quercus* all must be rejected as later homonyms under Articles 60 (3) and 61 of the International Rules of Botanical Nomenclature (Ed. 3. 1935). As no other names are available, new epithets are desired under Article 69. Two of the names were used earlier for fossils, which are not included in indexes of living plants. However, the rules of botanical nomenclature apply to recent and fossil plants alike (Article 9).

Though it may be questioned whether it is useful or necessary to give hybrids binominal names like species, as permitted by Article 31, this established custom is followed here for uniformity. In genera of many species that cross readily, the number of natural and artificial hybrids may exceed the total number of species. For example, the number of named natural hybrids of *Quercus* in the United States, already more than 70 and still growing, is greater than the number of native arborescent species of the genus. Experimental evidence of the origin and parentage has been presented for very few of these supposed oak hybrids. Muller (Amer. Midland Nat. **27**: 478. 1942) has recently suggested that some so-called hybrids of *Quercus* may be only miscellaneous variations unworthy of names.

×Quercus asheana Little, nom. nov. ASHE OAK

Quercus cinerea Michx. ×*Quercus laevis* Walt.

Quercus cinerea ×*catesbaei* Ashe, Journ. Elisha Mitchell Sci. Soc. **11**: 88. 1894; Small, Bull. Torrey Bot. Club **22**: 76, pls. 234, 235. 1895.

Quercus brevifolia ×*catesbaei* Sudw., U. S. Dept. Agr. Div. Forestry Bull. **14**: 170. 1897.

×*Quercus ashei* Trel. (*Q. catesbaei* ×*cinerea*), Proc. Amer. Phil. Soc. **56**: 48. 1917; *nomen nudum.* Sarg., Man. Trees North Amer. ed. 2, 254. 1922; *nomen nudum.*

×*Quercus ashei* Trel., Mem. Nat. Acad. Sci. **20**: 13, 156, 200. 1924. Non *Quercus ashei* Sterrett, Journ. Elisha Mitchell Sci. Soc. **37**: 178. 1922.

A new name is needed for the hybrid between *Quercus cinerea* Michx. (Hist. Chênes Amér. no. 8, pl. 14. 1801) and *Quercus laevis* Walt. (Fl. Carol. 234. 1788; *Q. catesbaei* Michx.) because ×*Quercus ashei* Trel. is a later homonym

[1] Received October 17, 1942.

dating from 1924 instead of 1917 (Article 45). ×*Quercus ashei* Trel. (Proc. Amer. Phil. Soc. **56**: 48. 1917) founded only upon "(*Q. catesbaei* ×*cinerea*)," without description or citation of a previous one, must be rejected as a *nomen nudum*, because under Article 31 the name of a hybrid is subject to the same rules as names of species. Mention of the two supposed parent species without description would not be valid publication of a hybrid binomial under Articles 37 and 44.

Before the name ×*Quercus ashei* Trel. was properly published in 1924 by reference to Ashe's early description, *Quercus ashei* Sterrett had been validly published in 1922 for another oak. *Quercus ashei* Sterrett was renamed *Quercus similis* Ashe (Journ. Elisha Mitchell Sci. Soc. **40**: 43. 1924), which is to be rejected under Article 60 (1) as superfluous, and was also reduced to a synonym of *Quercus stellata* f. *paludosa* Trel. (Mem. Nat. Acad. Sci. **20**: 104, 105. 1924). Thus, *Quercus ashei* Sterrett is a synonym, and *Quercus ashei* Trel. is a later homonym. The new epithet for the hybrid, the range of which is recorded as Georgia, also honors the discoverer of this oak, the late William Willard Ashe.

×**Quercus burnetensis** Little, nom. nov.

BURNET OAK

Quercus macrocarpa Michx. ×*Quercus virginia* Mill.

×*Quercus coloradensis* Ashe, Bull. Torrey Bot. Club **49**: 268. 1922.

Non *Quercus coloradensis* Lesq., Mus. Comp. Zool. Bull. **16**: 46. 1888 (fossil, Eocene, Colorado).

The later homonym ×*Quercus coloradensis* Ashe, named for a river in Texas, is a hybrid between *Quercus macrocarpa* Michx. (Hist. Chênes Amér. no. 2, pl. 2, 3. 1801) and *Quercus virginiana* Mill. (Gard. Dict. Ed. 8, Quercus no. 16. 1768). This hybrid was discovered by Ashe along the Colorado River above Marble Falls in Burnet County, Tex., from which county the new name is taken.

Quercus coloradensis Lesq. is a fossil species from the Tertiary (Eocene epoch, Denver formation) at Golden, Colo. It was described by Lesquereux from two specimens collected in 1883, but Knowlton (U. S. Geol. Surv. Prof. Paper no. 155: 54. 1930) later could locate only one specimen, which was so fragmentary that it was not worth figuring. Trelease (Mem. Nat. Acad. Sci. **20**: 27. 1924) cited *Quercus coloradensis* Lesq. among the fossil oaks of America but did not mention ×*Quercus coloradensis* Ashe, which was published just two years before Trelease's monograph. Camus (Les Chênes **2**: 754. 1939) noted that Ashe's hybrid was a later homonym but did not rename it.

×**Quercus cravenensis** Little, nom. nov.

CAROLINA OAK

Quercus cinerea Michx. ×*Quercus marilandica* Muenchh.

×*Quercus carolinensis* Trel. (*Q. cinerea* ×*marilandica*), Proc. Amer. Phil. Soc. **56**: 48. 1917; *nomen nudum*. Sarg., Man. Trees North Amer., ed. 2, 266. 1922; *nomen nudum*.

×*Quercus carolinensis* Trel., Mem. Nat. Acad. Sci. **20**: 14. 1924. Non *Quercus carolinensis* Muenchh., Hausvater **5**: 254. 1770. Non *Quercus caroliniensis* Young [Young, William, Jr.], Cat. Arbr. Arb. Pl. Herb. Amer. 53. 1783; *nomen subnudum*.

Quercus cinerea ×*nigra* Ashe, Journ. Elisha Mitchell Sci. Soc. **11**: 91. 1894.

The hybrid between *Quercus cinerea* Michx. (Hist. Chênes Amér. no. 8, pl. 14. 1801) and *Quercus marilandica* Muenchh. (Hausvater **5**: 253. 1770) should be given a new name, as ×*Quercus carolinensis* Trel. is a later homonym. ×*Quercus carolinensis* Trel. was published in 1917 as a *nomen nudum* based merely upon "(*Q. cinerea* ×*marilandica*)" and without description. In 1924 it was validly published by reference to Ashe's earlier description of *Quercus cinerea* ×*nigra*. The new name ×*Quercus cravenensis* is based upon the same description by Ashe (Journ. Elisha Mitchell Sci. Soc. **11**: 91. 1894), though the parent species formerly known as *Quercus nigra* now bears the name *Quercus marilandica*. The hybrid has been recorded from Craven County, N. C., from which the new epithet was taken, and from Georgia and Texas.

Strangely, ×*Quercus carolinensis* Muenchh., which was not included in the *Index Kewensis*, has not been mentioned by recent authors, though it was validated as a binomial in the same rare work with three other pre-Linnaean species. These three important species of eastern United States are *Quercus marilandica* and

Q. palustris, published by Muenchhausen on the preceding page, and *Q. coccinea*, published after *Q. carolinensis* on the same page.

As the identity of *Quercus carolinensis* Muenchh. is not clear, it seems best to pass over it as a *nomen dubium* (Article 63). No useful purpose would be served by adopting it and adding to the confusion among the old names of the genus already replacing other names and used with different meanings. *Quercus carolinensis* Muenchh. was based entirely upon *Quercus Caroliniensis, virentibus venis muricata* of Catesby (Nat. Hist. Car. Fla. Bahama Is. 1: 21, pl. 21, fig. 1. 1731), who in turn compared it with a slightly different, earlier species, *Quercus Virginiana rubris venis, muricata* of Plukenet (Alm. Bot. 309. 1696; Phytogr. pl. 54, fig. 5. 1691). Linnaeus (Sp. Pl. 996. 1753) cited, as synonyms of his variety *Quercus rubra* β, both Catesby's and Plukenet's species, but Muenchhausen without explanation asserted that *Q. carolinensis* was different from *Quercus rubra*. It was suggested by Valckenier Suringar (Rijks Herbarium Leiden Meded. 56: 11. 1928) that probably Linnaeus had not seen Catesby's and Plukenet's plants but referred to their drawings instead. Linnaeus's variety β was designated later as *Quercus rubra subserrata* Lam. (Encycl. Méth. Bot. 1: 720. 1785), with Catesby's and Plukenet's names as synonyms. Sargent (Rhodora 17: 38. 1915; 18: 46. 1916) interpreted Catesby's figure of a single leaf and an acorn to represent the northern red oak. When he proposed that *Quercus rubra* L. be rejected as a *nomen ambiguum*, Rehder (Journ. Arnold Arb. 19: 283–284. 1938) indicated also that Catesby's name apparently was referable to the northern red oak. Svenson (Rhodora 41: 522. 1939), in advocating the name *Quercus rubra* L. (emend. Du Roi) for the northern red oak, mentioned "the very crude figure by Catesby." Though *Quercus carolinensis* Muenchh. possibly might be interpreted as an available name for the northern red oak, it is hoped that this name of uncertain identification will not be adopted for any species.

Quercus caroliniensis Young, published in a commercial catalog with a very brief, indefinite French description, should be rejected as it is scarcely more than a *nomen nudum* and is not recognizable. It was not listed in the *Index Kewensis*.

×Quercus filialis Little, nom. nov.
VARILEAF OAK

Quercus phellos L. ×*Quercus velutina* Lam. ×*Quercus inaequalis* Palmer and Steyermark, Ann. Missouri Bot. Gard. 22: 521. 1935. Non *Quercus inaequalis* Watelet, Descr. Pl. Foss. Bass. Paris 136, pl. 35, fig. 8. 1866 (fossil, Eocene, France).

×*Quercus filialis* is a new name for the hybrid between *Quercus phellos* L. (Sp. Pl. 994. 1753) and *Quercus velutina* Lam. (Encycl. Méth. Bot. 1: 721. 1785). ×*Quercus inaequalis* Palmer and Steyermark must be rejected for this hybrid because it is a later homonym of the fossil species, *Quercus inaequalis* Watelet, from the Tertiary (Eocene epoch) in Belleu, France. (Incidentally, Watelet's fossil species was reduced to a synonym of *Pasaniopsis retinervis* Sap. and Mar. by Fritel, Journ. de Bot. 22: 160. 1909.) The range of this hybrid, according to Palmer and Steyermark, is from southeastern Missouri to Arkansas and Louisiana. The new epithet refers to the hybrid origin as the filial generation or offspring of a cross between parents of different species.

Sargent (Silva North Amer. 8: 180, pl. 436. 1895) interpreted ×*Quercus heterophylla* Michx. f. (Hist. Arb. Amér. 2: 87, pl. 16. 1812) as a hybrid between *Quercus phellos* and *Quercus velutina*, the supposed parents of ×*Quercus filialis*. However, Hollick (Bull. Torrey Bot. Club. 15: 303–309, illus. 1888) concluded that ×*Quercus heterophylla* Michx. f. was a hybrid between *Quercus phellos* and *Quercus rubra* (now *Quercus borealis* var. *maxima* (Marsh.) Sarg.). Later (Sci. Amer. 121: 422, 429–430, 432, illus. 1919), he demonstrated this parentage to be correct by planting acorns of the hybrid and obtaining among the young trees individuals like the two parent species and many intermediate ones. Small (Man. Southeast. Fl. 428, 430. 1933) designated ×*Quercus dubia* (without author) as a hybrid between *Quercus phellos* and *Quercus velutina*.

Osmanthus megacarpus (Small) Small ex Little, comb. nov. BIGFRUIT OSMANTHUS

Amarolea megacarpa Small, Man. Southeast. Fl. 1043, 1507. 1933.

Osmanthus megacarpa Small, Man. Southeast. Fl. 1043. 1933; as synonym.

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When he published the new genus *Amarolea* Small (Man. Southeast. Fl. 1043, 1507. 1933), a segregate from *Osmanthus* Lour. (family Oleaceae), Small described one new species, *Amarolea megacarpa* Small, listing at the end of the description and as a synonym the name "[*Osmanthus megacarpa* Small]." This name in *Osmanthus*, just cited as a synonym, was not validly published there under Article 40. The *Gray Herbarium Card-Index* and *Index Kewensis Supplementum* both stated that the name was published in synonymy and thus did not validate it. The combination is published here merely to avoid making it unintentionally.

BOTANY.—*Notes on American Euphorbiaceae, with descriptions of eleven new species.*[1] LEON CROIZAT, Arnold Arboretum of Harvard University. (Communicated by E. P. KILLIP.)

It was my privilege to visit the United States National Herbarium during the summer of 1941, and the descriptions and notes that follow are based largely upon material seen at that time. Herbaria at which the specimens cited in this paper are deposited are indicated thus: AA, Arnold Arboretum; GH, Gray Herbarium of Harvard University; US, U. S. National Herbarium.

Andrachne L.

Pax and Hoffmann completely misunderstood this genus within the American range. They treat[2] *Andrachne phyllanthoides* Nutt. as a species of *Savia* Willd., a manifest error as the floral morphology of these two genera is very different and they are not even closely related. *Andrachne* is nearest *Phyllanthus* and *Actephila*, whereas *Savia* is consanguineous with *Cleistanthus* and *Amanoa*. Further, these authors place *A. brittonii* Urb. in the section *Phyllanthidea*, which is another error as this species is not close to *A. microphylla* Baill., the standard-species of that section, but is probably nearest to *A. telephioides* L. *Andrachne* ? *cuneifolia* Britton, which is overlooked by Pax and Hoffmann in their account of the American species, is not an *Andrachne* but a species of *Phyllanthus* (see the new combination effected under *Phyllanthus*).

Andrachne microphylla (Lam.) Baill. Et. Gén. Euphorb. 577. 1858; Muell.-Arg. in DC. Prodr. 15[2]: 237. 1866; Pax & Hoffm. Pflanzenreich IV. 147. 15: 178. 1922.

Croton microphyllum Lam. Encycl. Méth. 2: 212. 1786.
Phyllanthidea microphylla Didr. Kjöb. Vid. Meddel. 1857: 150. 1857.

So far as I am aware, nothing in the literature indicates that this species has been reported since the time of Dombey. A fragment of the type, generously given me by Professor Humber of the Muséum d'Histoire Naturelle, Paris, shows that here belong (1) *Pennell* 14492—Peru: Depto. Lima: Near Viscas, along Río Chillón, alt. 1,800–2,000 meters (US); (2) *Haught* 39—Peru: Depto. Piura: Prov. Paita: Talara (US; distributed as "Tragia?").

Andrachne ciliato-glandulosa (Millsp.) Croiz., comb. nov.
Phyllanthus ciliato-glandulosus Millsp. Proc. California Acad. *II*, 2: 219. 1889.
Tragia ciliato-glandulosa M. E. Jones, MS. in sched. (*an tantum*?).

This annual, endemic to Lower California, so closely resembles *A. microphylla* as to be very easily confused with it. Its characters are those of *Andrachne* sect. *Phyllanthidea*, there being a minute pistillode in the female flower. Millspaugh erred in crediting this species to *Phyllanthus* sect. *Menarda*, with which it has no relationship. The occurrence of very similar plants in Peru and lower California is not altogether unexpected, but it is interesting to note that *A. aspera* Spreng., endemic from the Punjab to Morocco, is very closely allied to *A. microphylla* and *A. ciliato-glandulosa*, and that *A. phyllanthoides* from the United States, is near *A. colchica*, from the Caucasus. The distribution of all these species is undoubtedly pre-Tertiary.

[1] Received August 12, 1942.
[2] Pflanzenreich IV. 147. 15: 184. 1922; Nat. Pflanzenfam. 19c: 66. 1931.

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Phyllanthidea microphylla Didr. Kjöb. Vid. Meddel. 1857: 150. 1857.

So far as I am aware, nothing in the literature indicates that this species has been reported since the time of Dombey. A fragment of the type, generously given me by Professor Humber of the Muséum d'Histoire Naturelle, Paris, shows that here belong (1) *Pennell* 14492—Peru: Depto. Lima: Near Viscas, along Río Chillón, alt. 1,800–2,000 meters (US); (2) *Haught* 39—Peru: Depto. Piura: Prov. Paita: Talara (US; distributed as "Tragia?").

Andrachne ciliato-glandulosa (Millsp.) Croiz., comb. nov.
Phyllanthus ciliato-glandulosus Millsp. Proc. California Acad. *II*, 2: 219. 1889.
Tragia ciliato-glandulosa M. E. Jones, MS. in sched. (*an tantum*?).

This annual, endemic to Lower California, so closely resembles *A. microphylla* as to be very easily confused with it. Its characters are those of *Andrachne* sect. *Phyllanthidea*, there being a minute pistillode in the female flower. Millspaugh erred in crediting this species to *Phyllanthus* sect. *Menarda*, with which it has no relationship. The occurrence of very similar plants in Peru and lower California is not altogether unexpected, but it is interesting to note that *A. aspera* Spreng., endemic from the Punjab to Morocco, is very closely allied to *A. microphylla* and *A. ciliato-glandulosa*, and that *A. phyllanthoides* from the United States, is near *A. colchica*, from the Caucasus. The distribution of all these species is undoubtedly pre-Tertiary.

[1] Received August 12, 1942.
[2] Pflanzenreich IV. 147. 15: 184. 1922; Nat. Pflanzenfam. 19c: 66. 1931.

Phyllanthus L.

Phyllanthus cuneifolius (Britton) Croiz., comb. nov.

Andrachne? cuneifolia Britton, Mem. Torrey Club **16**: 72. 1920.

Apparently near *P. orbicularis* H.B.K., as it seems to have the stipitate ovary and the peculiar ♂ disc of that species.

A species published with a question mark as to the genus is not a nomen provisorium.[3]

Phyllanthus botryanthus Muell.-Arg. in DC. Prodr. **15**[2]: 323. 1866.

Glochidion botryanthum Pax & Hoffm. Nat. Pflanzenfam. **19c**: 58. 1931.

The two following collections, on comparison with *Plée* 55 and 56 (type material, AA), belong here: (1) *Pittier* 10521—Venezuela: San Martín, Río Palomar (AA); (2) *Pittier* 11914—Venezuela: Miranda: Puente de Turumo, road from Petare to Guatire, "Small tree in forest, up to 4 meters" (AA).

Pax and Hoffmann have an untenable concept of *Glochidion*. This may be retained as a genus only with the understanding that its species form a natural group that it is not possible to define with reference to a set of conventional characters. *Glochidion* is "good" in India, China, Indochina, and Malaysia but is apt to turn "bad" in New Guinea and Oceania, for here its characters merge with those of *Phyllanthus*. Naturally, it is a serious error to introduce *Glochidion* to the floras of America merely because certain species of American *Phyllanthus* have styles that tend to remain connate rather than to expand. These species may exhibit the *technicalities* of the style that are used to circumscribe *Glochidion*, but since they lack a *natural affinity* with this genus they can not be treated under it. I know few other families in which the problems of generic definition are so involved as those of the Euphorbiaceae, a genus under this family more often than not standing or falling on account of considerations that do not immediately bear upon the peculiarity of its floral morphology.

Phyllanthus L. Sect. Elutanthos Croiz., sect. nov.

Foliis fructibusque magnis, inflorescentiis laxe racemosis ramis filiformibus habitu effusis; perianthio utriusque sexus 6-lobo, staminibus saepissime in columnam connatis, disco in ♀ subconnato vel libero, in ♂ libero. Species typica: *Phyllanthus glaucescens* H.B.K. (= *P. adenodiscus* Muell.-Arg.).

Leaves and fruit usually large to very large but these not woody; inflorescence laxly racemose, 10–30 cm long, axillary or pseudoterminal, its axes mostly slender or filiform; flowers ♂ numerous, prevailingly clustered in groups, ♀ fewer, basal or apical; perianth usually 6-lobed, ♂ with 1–3 stamens connate within a staminal column or more seldom free, ♀ with a disk of erect, subconnate, or free glands alternating with the lobes.

Prevailingly Mexican and Central American woody endemics with a striking habit, reminiscent of certain Menispermaceae (e.g., *Hyperbaena* Miers), at first suggesting a genus other than *Phyllanthus* but closely related to classic species of this genus in every technical detail of their floral morphology. Standard-species: *Phyllanthus glaucescens* H.B.K. Nov. Gen. **2**: 115. 1817 (= *P. adenodiscus* Muell.-Arg. Linnaea **32**: 23. 1863).

The material of this section is insufficient and too imperfect to make an adequate key to the species, at least one, *P. oaxacanus* Brandeg., lacking staminate flowers. The following outline, however, will be of some use in distinguishing them. Two new species described below are included.

KEY TO THE SPECIES

Staminal column none; stamens 3, solute..... ..... *P. coalcomanensis* Croiz.

Staminal column present; stamens connate.

Anthers 2.... *P. tequilensis* Robins. & Greenm.

Anthers 6.

Male flowers delicate, lobes longer than broad; staminal column slender; axes of inflorescence often squamulose..... ..... *P. glaucescens* H.B.K.

Male flowers delicate; axes of inflorescence bearing flowers from pulvinate buds..... ..... *P. huallagensis* Croiz.

Male flowers not delicate with broadly ovate lobes; staminal column robust; axes of inflorescence not squamulose.

Inflorescence long, diffuse..... ..... *P. laxiflorus* Benth.

Inflorescence short..... ..... *P. chiapensis* Brandeg.

Male flowers unknown..... ..... *P. oaxacanus* Brandeg.

[3] See Croizat, Journ. Arn. Arb. **21**: 499. 1940; op. cit. **22**: 137. 1941.

Phyllanthus coalcomanensis Croiz., sp. nov.

Arbor; foliis magnis ad 15 cm longis; inflorescentia laxiflora; floris ♂ perianthio 6-lobo, ca. 6 mm lato, staminibus 3 liberis, glandulis discretis; floris ♀ perianthio 6-lobo, disco e glandulis discretis, ovario globuloso, stylis 3 reflexis. Ad *P. glaucescentem* H.B.K. accedit, at staminibus discretis statim dignoscitur.

A tree or shrub about 3 m high, the older bark reddish, wrinkled and lenticeled, quite glabrous; leaves 5–15 cm long, 4.5–12 cm broad, blackish when dried (only young leaves seen), thinnish, probably slightly glaucescent beneath in life, broadly ovate, very broadly acuminate at the tip, truncate to truncate-cordate at the base, with about six pairs of spreading primaries, widely branching toward the margin of the blade; petiole not over 1 cm long; stipules nearly petaloid in texture at least at the margin, irregularly broad-ovate, entire, much veined, up to 1 cm long, 0.7 cm wide; inflorescence ♂ of effuse, many-flowered sub-filiform lateral and subterminal racemes up to 25–30 cm long, monoecious; inflorescence ♀ perhaps fascicled and axillary but, more likely, occupying the basal part of some or all the ♂ axes; flower ♂: perianth about 6–7 mm broad on a slender pedicel about 6–8 mm long, the lobes 6, hyaline, costate in center, ligulate, rounded at the tip, about 3 mm long, alternating with as many disciform to globulose glands (nectaries), these not forming a continuous disk; stamens 3, free, connate merely at the base; filaments fleshy about 1 mm long ,the anthers transverse; flower ♀: perianth (not dissected, only one seen) up to 20 mm broad on a pedicel about 15 mm long, the lobes apparently 5, blackish when dry, thinly hyaline at the margin, broadly ovate to rotundate, about 8 mm long and broad; ovary globulose, quite glabrous, manifestly sulcate on the keels and commissures, about 4 mm long and wide; styles 3, reflexed, apparently shortly bilobed at the tip, about 1–1.5 mm long; glands as many as the lobes and alternating with them, erect, puncticulate at the upper lip, apparently not connate into a close disk.

Type: *Hinton* 15857, Mexico: Michoacán, Distr. Coalcomán, Aquila, 400 meters. "Tree 3 meters high. Flowers white, raceme pendulous, in barranca" (US). Syntype: *Hinton* 15859, same locality and date, "2 meters high. Flowers purple, racemes pendulous; different from 15857" (US).

Hinton 15857 and 15859 are the same species, the collector having been misled by the changing color of the flowers, apparently purple at unfolding or before unfolding, white in full anthesis.

Phyllanthus huallagensis Standl. MS. in sched.

Arbor, foliis ad 9 cm longis, subtus glaucescentibus: inflorescentia racemosa ad 25 cm longa; floris ♂ perianthio ca. 4 mm lato, staminibus 3 in columnan connatis, glandulis discretis; floris ♀ perianthio ca. 6 mm lato, glandulis subconnatis, ovario globuloso ad 2 mm lato, stylis 3 brevibus. *Phyllanthum tequilensem* Robins. & Greenm. admonet.

A tree, 6 m high, quite glabrous, the older bark much lenticeled and fissured, reddish brown; leaves 4–9 cm long, 3–5 cm broad, brownish when dried, firmly chartaceous, glaucescent beneath in life and slightly so in dried specimens, round-elliptic, shortly and broadly acuminate at the tip, cuneate to round-cuneate, not cordate at the base, with about six pairs of broadly ascending primaries, conspicuous beneath, less so above, the veinlets fairly conspicuous; petiole less than 5 mm long; stipules triangular, small, apparently not long persistent; inflorescences of axillary and subterminal, slender but not filiform racemes up to 20–25 cm long, bearing numerous clustered ♂ flowers arising from manifestly pulvinate buds and many less ♀ flowers, as seen in an apical position; flower ♂: perianth about 4 mm broad, borne on a slender pedicel about 10 mm long, the lobes 6, more or less ovate to elliptic, about 2 mm long and 1.5–2 mm broad, alternating with 6 small glands; stamens 3, fused into a staminal column about 1 mm long; flower ♀: perianth about 5–6 mm broad, borne on a pedicel about 3.5 mm long, the lobes 6, more or less ovate, 1.5–2 mm long, alternating with six suberect curved glands, almost connate to form a continuous disc underneath the ovary; ovary globose, about 2 mm long and broad; styles 3, short, more or less reflexed and cleft at the tip.

Type: *Klug* 4240, Depto. San Martín, Peru: Juan Jui, Alto Río Huallaga, alt. 400–800 meters, in forest, Jan. 1936 (AA).

This is the only species of this section known, so far, from Peru, somewhat reminiscent of *P. tequilensis* Robins. & Greenm. from Mexico and not too far removed from *P. botryanthus* Muell. from Venezuela.

As a further help in sight-identification of species of the section *Elutanthos*, the following ranges are given: *P. coalcomanensis*, Michoacán, Mexico; *P. tequilensis*, Jalisco, Mexico; *P. glaucescens* (including *P. adenodiscus*, which might be retained as a variety in a critical study of this group, but does not impress me as having a clear specific status), the entire eastern coast of Mexico from British Honduras and Yucatan to Tamaulipas, Mexico; *P. laxiflorus*, Guatemala; *P. chiapensis*, Chiapas, Mexico—very near *P. laxiflorus* as far as seen; *P. huallagensis*, Depto. San Martín, Peru; *P. oaxacanus*, Oaxaca, Mexico. These ranges are fairly indicative of the various centers of endemism for the Euphorbiaceae of this region.

Phyllanthus neoleonensis Croiz., sp. nov.

Fruticulus ligneus, intricatus; foliis vix 2 cm longis, petiolis quam stipulis brevioribus, vix 2 mm longis; inflorescentia cymulosa, axillari; perianthio floris ♂ ca. 2 mm lato, 6-lobo, staminibus 3 ad basem liberis, glandulis 6 liberis; perianthio floris ♀ ca. 5 mm lato, 6-lobo, stylis brevibus; semine trigono, arillo granuloso scabro. *Phyllanthum galeottianum* Baill. atque *P. liebmannianum* Muell.-Arg. admonet.

A low, woody and much intricate shrub, probably not over 1–2 feet high, the innovations herbaceous or subherbaceous, quite glabrous, the older shoots woody, slender, sometimes zigzag; leaves 1–2 cm long, 0.5–1.5 cm broad, obovate to elliptic, rounded and obscurely mucronate at the tip, more or less rounded to cuneate at the base, pale olive above, grayish or pink-grayish underneath, the primaries obscure, delicate, about 4–5 pairs; petiole less than 2 mm long; stipules 2–3 mm long (that is, longer than the petioles), setaceous towards the tip, irregularly broadened towards the base, venulose, mostly purplish; inflorescences bisexual in axillary cymules; flower ♂: perianth about 2–2.5 mm wide on a slender pedicel about 4 mm long, the lobes 6, elliptic to elliptic-ovate, 1.5 mm long, 0.75 mm broad, alternating with as many roundish glands: stamens 3, free except at the very base; flower ♀: perianth about 5 mm wide, on a pedicel about 10 mm long: lobes 6, about 2–2.5 mm long, 1.5–2 mm wide, ovate, sometimes acuminate and slightly glandular at the tip, glands 6, erect, curving against the ovary, not connate into a disc; ovary glabrous, 2 mm long and wide or less, sulcate; styles 3, short, barely bilobed at the apex; seed trigonous, 2 mm long, 1.5 mm broad, the testa brown, smoothish, the aril black, as a loose, hard, granular dust on the testa.

Type: *Pringle* 13881 bis, Nuevo León, Mexico: Limestone ledges, Sierra Madre, near Monterrey (GH). Syntypes: *C. H. & M. I. Mueller* 314 & 315, same locality as the type (AA); *Pringle* 10810, Monterrey (GH); *Pringle* 1198, Sierra Madre (GH).

The Muller material was originally determined with doubt as *P. ferax* Standl., a species that *P. neoleonensis* superficially resembles in its vegetative characters but from which it differs in the much more robust habit and in the details of floral morphology. *Phyllanthus galeottianus* Baill., which is in all probability represented by *Pringle* 4443, collected near Guadalajara, Jalisco (GH), is unlike *P. neoleonensis* because of its more robust habit and its stamens being connate to form a staminal column. A plant bearing some resemblance to *P. neoleonensis*, but more delicate and probably not different from *P. liebmannianus* Muell.-Arg., is represented by *Purpus* 2313, Zacuapan and vicinity, Veracruz (GH). Lastly, *Gaumer* 508, *Gaumer* 1817, *Gaumer & Sons* 23543 (all *AA*), distributed as *P. lathyroides*, are probably conspecific with *P. ferax* Standl. (*Bartlett* 12157, Petén, Guatemala; US).

Phyllanthus mexiae Croiz., sp. nov.

Frutex; foliis setaceis, bracteis in ramulis florigeris (vulgo pro foliis laudatis) ad 4 cm longis; inflorescentia cymulosa axillari; floris ♂ perianthio ca. 2 mm lato, staminibus 3 in columnam connatis; floris ♀ perianthio ca. 7 mm lato, 6-lobo, ovario vix 1 mm magno, stylis 3 brevibus.

A shrub, quite glabrous, the innovations smooth and ribbed; leaves (strictly speaking) none, transformed into acuminate stipules 2 mm long or less, marcescent at the axil of the stiffly spreading, leafy-bracteate florigerous

axes; bracts of the florigerous axes ("leaves") 2.5–4 cm long, 2–2.5 cm broad, elliptic-ovate, thinly membranous, greenish above, pale grayish below but probably not glaucescent, very broadly acuminate, sometimes mucronate at the tip, more or less broadly and irregularly cuneate at the base with 5–7 pairs of thin primaries; petiole about 3 mm long; stipules triangular, not over 2 mm long, marcescent or deciduous; inflorescences bisexual in lax clusters in the axils of foliaceous bracts ("leaves"); flower ♂: perianth 2 mm broad or less, on a capillary pedicel 3–5 mm long, the lobes thin, hyaline, the glands 3 surrounding the base of the column formed by 3 connate stamens, about 1.5 mm long; flower ♀: perianth about 7 mm broad on a pedicel about 10 mm long, the lobes 6, ovate-elliptic, 3 mm long, 1.5 mm broad, hyaline, thinly greenish-costate along the middle, alternating with as many erect, incurved, more or less regular glands; ovary glabrous, somewhat depressed, about 1 mm long and wide, with 3 reflexed styles, short and manifestly cleft at the tip.

Type: *Ynes Mexía* 6718, Ecuador, Prov. of Leon, Canton Pajilli: Hacienda Solento, near Santa Rosa, alt. 1,000 meters, "shrub 5 m. high, in forest in cloud belt. Fish-poison," Nov. 1934 (US).

In certain groups of *Phyllanthus* true leaves are present, the florigerous axes being often reduced, bracteate, and, strictly speaking, leafless branchlets (see *P. laxiflorus*). In other groups of the same genus the true leaves are represented only by scales, the aspect and function of foliage being assumed by the bracts of the florigerous axes (see *P. mexiae*). These peculiarities, seldom if ever noticed, are of the utmost importance because they furnish a ready key to the understanding of all the very variable inflorescences of the phyllanthoid alliance. It is worthy of note that true leaves appear on seedlings of species (e.g., *E. niruri* L.) which in their more mature aspect bear only "leafy" florigerous axes.

Croton L.

Croton aristophlebius Croiz., sp. nov.

Ligneus; apicibus brunneo-ochraceis, subargillaceo-tomentosis; foliis elliptico-lanceolatis ad 12 cm longis, venulis venisque valde impressis, primariis ca. 9–12 jugis; perianthio floris ♀: lobis sub fructu discretis, ca. 6 mm longis, pedicello ca. 15 mm longo, columella ad 7 mm longa.

Crotonem celtidifolium Baill. habitu bene simulat at indumento toto caelo discrepat.

A tree or shrub; innovations brown-ochraceous, the indumentum of rough, very persistent, subargillaceous trichomes; leaves 6–12 cm long, 2–5 cm wide, elliptic-lanceolate, acuminate to short-caudate at the tip, round-cuneate at the base, glabrous, dull green, smooth above, with sharply impressed veins and veinlets, underneath pale-ochraceous, the indument compactly scurfy-tomentose, the veins about 9–12 pairs, anastomosing near the entire margin, the tertiary veins sharp; petiole 1.5–2.5 cm long, vestite like the innovations, bearing 2–4 pedicelled, disciform glands at the apex on the abaxial face of the blade; stipules almost none; inflorescence of spicate, bisexual axes, rather slender, up to 15–20 cm long; flower ♂: perianths immature, about 2 mm long; flower ♀ (only the perianth seen after fruiting): calyx about 12–14 mm wide, on an ascending, ultimately recurved pedicel about 14–17 mm long, rather slender, the lobes 5, entire, ligulate to elliptic, short-acuminate to rounded at the tip, nowhere imbricating, 5–6 mm long, 1.5–2 mm wide, not accrescent; petals as setaceous brownish ligulae between the sepals; columella after dehiscence about 7 mm long.

Type: *Bro. Daniel* 1912, Depto. Antioquia, Colombia: Piedras Blancas, July 1938 (US).

A strong species, distantly suggesting *C. celtidifolius* Baill. but with a very different indumentum.

Caperonia St.-Hil.

Caperonia chiltepecensis Croiz., sp. nov.

Herba, indumento delicato interdum glanduloso; foliis elliptico-lanceolatis vel obovatis, nervis primariis ca. 10–14-jugis, haud profunde dentatis; floris ♂ perianthio delicato, sepalis triangularibus ca. 1.5 mm longis, petalis tenuissimis, ligulatis ad 2 mm longis, staminibus ca. 10 in serie duplici dispositis; floris ♀ perianthio ad 5 mm magno, sepalis petalisque cum ♂ sat congruentibus, ovario depresso 1 mm longo, 2 mm lato, dorso processibus 5–7 in cocco quolibet ornato. *Caperoniam saponetam* Mansf. Peruvianam potius in mentem vocat quam *C. palustrem*, at magis delicata est.

Herb with dimorphic pubescence of short, appressed setulose eglandulose hairs and more or less spreading, delicate glandulose trichomes, these not over 1 mm long; leaves fairly thin, greenish on both faces, 5–8 cm long, 2–4 cm broad, elliptic-lanceolate at the apex of the shoot, more or less regularly obovate at its base, sparingly and weakly setulose on both faces, the indumentum scattered below, mostly restricted to the primaries above, the primaries in 10–14 pairs, thin, ascending the tertiaries manifest, the serration shallow, the teeth barely spreading at their apex, the petiole 5–10 mm long; stipules setaceous, up to 3–4 mm long; inflorescences on slender axillary axes, short-branching or dichotomous, up to 8–10 cm long: flower ♂: perianth delicate, about 3 mm broad; sepals 5, about 2.5 mm long and 1.5 mm wide, triangular; petals very thin, ligulate, about 2 mm long, 1.5–2 mm broad; stamens apparently 10, alternating in two even series, the lower subsessile, the upper borne upon a staminal column 1–1.5 mm long with filaments 0.5–1 mm long; flower ♀: perianth 4–5 mm broad, with a pedicel about 2.5 mm long; sepals 5, elliptic, entire, slightly glandular and cucullate at the apex, somewhat strigulose on the back: petals 5, very thin, white, 2–3 mm long, abruptly produced at the base into a filiform claw about 1 mm. long, otherwise ligulate, rotundate at the apex; ovary depressed, 1 mm long, 2 mm broad, each keel bearing 5–7 triangular processes, fleshy at the base, glandulose at the apex: styles 3 flabellate, irregularly cleft into 5–6 nearly terete branches, about 3–4 mm long.

Type: *Martínez-Calderón* 334, Mexico, Oaxaca: Distr. Tuxtepec, Chiltepec and vicinity, 20 meters, 1941 (US).

Despite its being much more delicate in all its parts this species seems to be most closely allied with *C. Zaponeta* Mansf., from Peru (*Klug* 3954, *GH*). It differs from *C. palustris* St. Hil. in the finer indument, in the less open and spreading serration, in the different epicarp, and in the general outline of the foliage.

Jatropha L.

Jatropha deutziiflora Croiz., sp. nov.

Stimulosa, folia visa ad 35–27 cm magna, 7-loba, basi optime sinuata; inflorescentia longe pedunculata ca. 40 cm longa; perianthio floris ♀ ca. 10 mm longo, lobis 5 albicantibus, carnosulis, calyptratim deciduis; ovario glaberrimo 3 mm longo in disco insidente integro ca. 1 mm crasso, stylis 3, quolibet apice in laciniis 6 diviso. Cum *J. longipede* Pax e descriptione congruere videtur, in sect. *Calyptrosolene*.

Probably a large shrub, the specimen consisting only of a leaf, a petiole, and a cyme with ♀ flowers; leaf large, about 27 cm long, 35 cm broad, quite glabrous on both faces, very thin, brittle, greenish on both faces with brownish veins, 7-lobed, the 3 median lobes subsimilar, about 20 cm. long and 8 cm wide, with about 7–9 pairs of broadly spreading primaries and with distant tertiaries often running parallel to the main veins, the margin of the lobes coarsely and not profoundly dentate, lined by numerous stimulose hairs, these not over 1.5–2.5 mm long, inconspicuous, almost parallel with the margin the lateral lobes falcating and shorter, the external 2 hardly more than lobules, 5–6 cm long, about 3.5 cm broad, the base of the leaf cut to form a wide sinus very nearly lined by the excurrent midribs of the outer lobes, the petiole quite herbaceous, ribbed, glabrous; inflorescence a long-peduncled cyme about 40 cm long, armed below with ascending, rather small, stimulose hairs, becoming almost unarmed and finely puberulous at the tip, the flowers much crowded upon short dichotomous branches; perianth ♀ about 10–11 mm long, the 5 lobes about 8 mm long, 3 mm broad, obovate to subspatulate, fleshy, quite whitish, falling off neatly from the persistent greenish base of the perianth; ovary quite glabrous, 3 mm long, 2 mm broad, on a continuous disk about 1 mm thick; styles 3 about 2.5–3 mm long, each divided at the tip into about six branches, these sometimes shallowly cleft or lobed at the apex.

Type: *Martínez-Calderón* 77, Mexico, Oaxaca: Tuxtepec, Chiltepec and vicinity, alt. about 20 meters, July, 1940–February, 1941 (US).

Nearest to *J. longipes* Pax from Colombia. Differs from the Mexican species of sect. *Calyptrosolen*, to judge from descriptions, in the glabrous ovary.

Manihot Mill.

Manihot aesculifolia (H.B.K.) Pohl, Pl. Bras. Ic. Descr. 1: 55. 1827; Muell.-Arg. in DC. Prodr. 15²: 1065. 1866; Pax & Hoffm. Pflanzenreich IV. 147. 2: 58. 1910.

Janipha aesculifolia H.B.K. Nov. Gen. **2**: 85. pl. 109. 1817.

Pax describes this species as having "limbus membranaceus, basi cordatus, concolor," listing only the type, collected by Humboldt on the Gulf of Campeche. *Bangham* 300, Honduras: San Pedro Sula, 1929 (AA), erroneously distributed as *M. dulcis*, so perfectly agrees with the type-illustration of *M. aesculifolia* in its vegetative and in floral characters that I have little hesitation in referring it to this species, despite its having a leaf that is not "concolor" but strongly glaucescent at the lower face.

Manihot dulcis (J. F. Gmel.) Pax, Pflanzenreich, IV. 147. **2**: 71. 1910.

Jatropha dulcis J. F. Gmel. Onom. Bot. **5**: 7. 1772–1778, *fide* Pax.

Three collections from Peru, which very likely represent the same species are: *Killip & Smith* 22722, Depto. Ayachuco: Aina; *Klug* 2662, Depto. San Martín: Pongo de Cainarachi; *Skutch* 5009, Depto. Loreto: Río Ucayali (all AA). In this plant the leaf is almost always 3-foliate, sparingly pubescent to glabrate on the veins, innovations, and floral axes. The Skutch collection has a fruit that lacks "wings," which, taken together with all the other characters, identifies the specimens cited as *M. dulcis*, in the sense of Pax. *Killip & Smith* 22722 shows remnants of a fine rufous pubescence and may be *M. dulcis* var. *ferruginea* (Muell.-Arg.) Pax, accepted by Mueller for the subandine regions of Peru (*DC.* Prodr. **15**[2]: 1063. 1866, under *M. palmata* (Vell.) Muell.-Arg.), but questioned there by Pax. *Manihot pavoniana* Muell.-Arg., another Peruvian species, agrees so far as the descriptions with the cited collections in some characters, but differs in the glabrous perianth and stamens. *Killip & Smith* 22722 and *Klug* 2662 have been identified as *M. utilissima* Pohl, a determination which the fruit of *Skutch* 5009 now shows to be untenable.

Gymnanthes Swartz

Gymnanthes texana Standl. Proc. Biol. Soc. Washington **39**: 135. 1926.

This species is to be excluded from the Euphorbiaceae. Inspection of *Tharp* 3634, the type in the U. S. National Herbarium, having convinced me that the plant was not of this family, I called it to the attention of E. J. Palmer, of the Arnold Arboretum, and of V. L. Cory, of the Texas Agricultural Experiment Station in Sonora. Both these botanists promptly recognized it as *Forestiera reticulata* Torr., an identification confirmed by the characters of the wood of *Tharp* 3634, which show unquestionable kinship with the Oleaceae. I am deeply indebted to Mr. Cory for the following additional data (*in litt.*, Nov. 24, 1941): "[Tharp's] material is identical with that which I collected on a hillside sixteen miles north of Comstock on August 15 of this year. My study had convinced me that this was *Forestiera reticulata* Torr. Mr. Ernest J. Palmer reports that my material undoubtedly is of that species. The peculiar thing about this plant is the remarkable difference between the pistillate and the staminate aspect. In my limited observation, the former grows to an height of six feet or more, with leaves that are prominently porulose beneath, and the plant is, in appearance, a typical *Forestiera*. On the other hand, the staminate plant, or at least the one I have seen growing, is a foot or less in height with the aspect of a shrubby species of *Croton* and the leaves imperceptibly porulose. I made additional collections from this plant on November 12 and at this time it was easy to take it as a *Forestiera* and not a spurge."

The following synonymy is consequently affirmed:

Forestiera reticulata Torr. U. S. & Mex. Bound. Bot. 168. 1859 = *Gymnanthes texana* Standl. Proc. Biol. Soc. Washington **39**: 135. 1926.

Senefeldera Mart.

The generic name has been spelled *Senefeldera* and *Sennefeldera*, and Mueller-Argoviensis has proposed[4] the latter spelling as an alternative to the former. The correct version is *Senefeldera* as given[5] by Pax and Hoffmann, the genus having been named by Martius in honor of Alois Senefelder (1771–1834), a citizen of Munich, and the inventor of lithography. The name of the lithographer of Vellozo, Flora Fluminensis, as shown on the title-page of this work, is Senefelder.

[4] Mart, Fl. Bras. **11**[2]: 528. 1874.
[5] Pflanzenreich IV. 147. 5: 23. 1912.

Senefeldera verticillata (Vell.) Croiz., comb. nov.

Omphalea verticillata Vell. Fl. Flum. **10**: pl. 15. 1827.

Senefeldera multiflora Mart. Flora 24², Beibl. **2**: 29. 1841; Pax & Hoffmann, Pflanzenreich IV. 147. **5**: 23. 1912.

Pax and Hoffmann and J. Mueller have placed *O. verticillata* Vell. in the synonymy of *S. multiflora* Mart., failing, however, to effect the combination required under the International Rules. I present this combination here, believing that Vellozo's plate 15 (not 152, as cited by Pax and Hoffmann) is correctly understood by all these authors to illustrate *Senefeldera*, not *Omphalea*.

Senefeldera macrophylla Ducke, Arch. Jard. Bot. Rio de Janeiro **4**: 113. 1925.

To this species or to a very nearly related one belongs A. C. Smith 2960 (AA), collected on the southern slopes of the Akarai Mountain in the drainage basin of Rio Mapuera, Pará, Brazil, 1938.

Senefeldera nitida Croiz., sp. nov.

Arbor; foliis 10–18 cm longis, 6.5–8 cm latis, late ellipticis, apice breviter acuminato-mucronatis, more proprio nitidis, venis primariis ca. 12-jugis; capsula submatura 1.5 cm longa, 2.5 cm lata, laevissima.

A medium-size tree with quite glabrous innovations; leaves 10–18 cm long, 6.5–8 cm broad, very broadly elliptic and very broadly and shortly acuminate-mucronate, coriaceous, brownish, glossy on both faces but especially above, quite entire, very obscurely cordate at the base and here barely glandular, the glands scarlike and inconspicuous; primaries about 12 pairs, all patent, thin but sharp, the anastomoses inconspicuous, the petiole 3–4 cm long; inflorescence seen only in fruit and mostly broken off, typical of the genus, subapical and many-branched, the branches stoutish; only one capsule seen, almost ripe, 1.5 cm long, 2.5 cm broad, manifestly trigonous and depressed, the rounded keels of the cocci thinly grooved, the epicarp quite smooth.

Type: *Krukoff* 7126, Brazil, State of Amazonas: Basin Rio Madeira, Municipality Humayta, on plateau between Rio Livramento and Rio Ipixuna, 1934 (AA).

Distributed as *S. karsteniana* Pax & Hoffm., *Triana* 5791–1, in the Colombian National Herbarium, collected at Villavicencio, the classic locality of *S. karsteniana*, and in all probability this species, is certainly different from *Krukoff* 7126. The peculiarly glossy foliage is characteristic.

Senefeldera skutchiana Croiz., sp. nov.

Arbor; foliis 15–10 cm longis, 8–3 cm latis, late ellipticis, nervis primariis ca. 10–14-jugis utrinque conspicuis, glandulis nullis vel subnullis, petioli apice atrato; inflorescentia apicali, paniculam decompositam simulante; floribus ♂ vulgo ternatis, staminibus 5–8 in bracteolae axilla ad 2 mm longae, margine hyalino erosae; floribus ♀ bracteis 3 integris lanceolatis circumdatis, ad 2.5 mm longis, interdum flore laterali ♂ auctis, ovario ad 2 mm longo subfusiformi, stylis carnosis vix divaricatis.

A medium-sized tree, quite glabrous; leaves 10–15 cm long, 3–8 cm broad, firmly chartaceous to subcoriaceous, greenish when dry, broadly elliptic, short-acuminate to apiculate at the tip, the apex of the blade slightly glandular at the end of the midrib and here somewhat reflexed, broadly cuneate to subrotund at the base, the margins entire, the primary veins about 10–14 pairs, sharp on both faces not all anastomosing, the glands almost wanting, only the apex of the petiole slightly enlarged, blackish when dry, and the base of the blade in certain leaves obscurely spotted above, near the insertion of the petiole, the petiole comparatively slender, 2.5–8 cm long; inflorescence apical, of numerous spiciform stiffish axes, about 20 cm long and wide, appearing as if compound-panicled, the ♂ flowers very numerous, the ♀ fewer and basally borne or tending to be mixed with the staminate on certain axes; flowers ♂ usually borne in 3's in the axil of an ovate to elliptic-ovate scale, 1.5–2 mm long, erose and thin at the margin, the central flower very seldom reaching maturity in the lower part of the florigerous axes but usually evolute and alone in the upper one by abortion of the lateral flowers, the pedicel with a low articulation, about 2 mm long, bearing adaxially a bract, open and holding 5–8 stamens about 1.5–2 mm long; flower ♀: perianth of 3 lanceolate entire imbricate bracts, sometimes glandular at the base inside,

about 1.5–2.5 mm long, with an occasional lateral ♂ flower; ovary 1.5–2 mm long, tapering at both ends with rather fleshy styles not divaricate, as seen, about 3 mm long.

Type: *Skutch* 4967, Peru, Depto. Huánuco, Tingo María, alt. 2,500 feet, a tree 60 feet high with yellowish flowers, August, 1940 (AA). Syntype: *Skutch* 4961, same locality and date, at 2,300 feet, (AA).

A very distinct species, suggesting at first sight some rutaceous plant (for instance, resembling *Evodia*), with comparatively slender and numerous florigerous axes.

Pedilanthus Neck.

I reinstated[6] *Tithymalus* Mill., this being the earlier validly published name for this group, but *Pedilanthus* has subsequently been proposed[7] as a *nomen genericum conservandum* by Wheeler. In view of the existing international situation it is not likely that the Botanical Congress can decide in the near future between *Tithymalus* and *Pedilanthus*. Thus, not to deepen the existing controversy and further to disturb nomenclature, I accept *Pedilanthus* as proposed by Wheeler.

Pedilanthus coalcomanensis Croiz., sp. nov.

Arbor 15-pedalis: innovationibus inflorescentiis lanulosis; bracteis floralibus conspicuis, vinosis, ad 2.5 cm longis; cyathio horizontali calcarato 15 mm longo, 10 mm lato; appendice integra ad 10 mm longa, apice callosula, dorso impresso-canaliculata, glandulis 4, lobis superis 3 connatis, apice acuminatis, lobis lateralibus 2 apice rotundato-carinatis; floribus ♂ (staminibus) ad 30; flore ♀ (ovario) ad 4 mm longo (ut adest), gynophoro 5–7 mm longo, stylo filiformi ad 13 mm longo, apice breviter trifido, cruribus ad 2 mm longis. Species more proprio bracteata, appendice cyathii integra.

A tree about 5 m high; innovations lanulose, older wood with a grayish smooth bark, glabrous; leaves seen none; inflorescence surrounded by conspicuous bracts of variable length but probably not longer than 2.5 cm and about 1.75–2.25 cm broad, ovate, mucronulate, subcordate at the broadly clasping base, wine-colored at the margins, softly whitish pubescent, indument lanulose; internodes of the cyme scarcely over 1 cm long, all lanulose; cyathium manifestly calcarate, about 15 mm long, and 10 cm broad, the anterior margin rounded, the posterior evidently produced, horizontal or nearly so, wine-colored, on a pedicel about 10–12 mm long, sparingly lanulose; appendix entire, about 10 mm long, that is, shorter than the cyathium, bearing three grooves above, ending in an entire or scarcely lobulate glandular tip; glands four, set under the fornicate appendix, not stipitate, rather small; upper calyx-lobes 3, connate for a longer or shorter tract, about as long as the lateral calyx-lobes, acuminate; stamens (in reality, ♂ flowers) about 20–30, 10–15 mm long; ovary (♀ flower), as seen, about 4 mm long, 2.5 mm broad, glabrous, on a gynophore about 5–7 mm long; style filiform, 10–13 mm long, shortly trifid at the tip, the branches 1.5–2 mm long, slightly cleft to bilobed.

Type: *Hinton* 15765, Mexico: Coalcomán, Michoacán. Sierra Naranjillo 1,550 m, tree 5 m, bracts red, locally known as *candelilla*, in woods, 1941 (US).

The apparently involved morphology of the cyathium of *Pedilanthus* can easily be explained, if only it is realized that this cyathium is homologous with a much coarctate inflorescence of *Dalechampia*, the upper part of the inflorescence, which bears glands and ♂ flower in this genus, being replaced by a chamber with glands in *Pedilanthus*. The lower part of the inflorescence carries three ♀ flowers in *Dalechampia* but only one ♂ flower and numerous ♀ flowers in *Pedilanthus*. It stands to reason that the structural details of the cyathium of *Pedilanthus* have as much taxonomic significance as those of the inflorescence of *Dalechampia* and that, unlike *Euphorbia* and *Chamaesyce*, *Pedilanthus* can readily be keyed on floral characters once the proper position and evolution of these characters is understood.

Millspaugh's fundamental paper[8] keys out the species of sect. *Eupedilanthus* in two groups,[9] one having an appendix entire, the other bipartite. The latter group is once again divided into two lesser divisions, with and without colored floral bracts. *Pedilanthus coalcomanensis* thus belongs to a group of its own,

[6] Amer. Journ. Bot. **24**: 703. 1937.
[7] Contr. Gray Herb. no. **124**: 47. 1939.
[8] Field Mus. Bot. **2**: 353–371. 1913.
[9] *Op. cit.* 354.

having an entire appendix and colored floral bracts. I find no species, either in the herbaria I have visited or in the descriptions I have read, that agree with this new one.

Pedilanthus personatus Croiz., sp. nov.

Frutex ad 10 ped. altus; innovationibus puberulis; cyathio calcarato, horizontali ad 12 mm longo, 8 mm lato, appendice 8 mm longa, acuminata, ad basem imam partita, glandulis 4, quarum 2 in infundibulo sacciformi ex appendice fornicata, 2 in suturis inter lobos superos lateralesque; lobis superis 3, longe acuminatis vix connatis; floribus ♂ (staminibus) ad 20 vel ultra; flore ♀ (ovario) tomentello ca. 2.5 mm longo, gynophoro optime articulato, stylo ca. 10 mm longo, stigmatibus brevissimis.

A shrub 10 feet high; stems pale green, puberulous at the tips, the inflorescence congested in apical, very short cymes; leaves and bracts not seen; cyathium puberulous, about 10–12 mm long and 8 mm broad, the appendix fully 8 mm long, rather pointed, cleft down to its obscurely saccate base, bearing at the base and on either side 2 stipitate glands; lateral lobes 2, rounded at their apex; upper lobes 3, subconnate and readily separating, about 10 mm long, slightly spatulate at the tip, the lateral 2 bearing each a gland along the line of connation with the adjacent lobes, these two glands being visible from the outside in a characteristic manner (hence the specific name); stamens (♂ flowers) numerous, 20 or more; ovary (♀ flower) finely grayish-tomentellous, about 2.5 mm long, on a gynophore deeply articulate, ca. 10 mm long, the style about 10 mm long, incrassate at the base; stigmas very short, apparently cleft and elobulate.

Type: *J. B. Edwards* 581, Honduras, Comaguaya, in semiarid country, at 1,800 feet, locally called "ditamo real," February, 1933 (*AA*).

Distributed as *P. macradenius* Donn. Smith, an altogether different species. It keys near *P. oerstedii* Kl. & Garcke and *P. aphyllus* Boiss., but it does not agree in the slightest with the latter, as interpreted by Millspaugh[10] and illustrated by *Botteri* 968 (GH). *Pedilanthus oerstedii* is published with an inadequate description, there being a possible question whether its status is better than that of a *nomen nudum*. Its classic locality is not far from that of *P. personatus* but it may not be the same species if, as it is affirmed[11] by Boissier and by Millspaugh, it is closely related with *P. aphyllus*, The specimen of *P. oerstedii* is now inaccessible.

[10] *Op. cit.* 367.

Euphorbia L.

Euphorbia crispata Hornem. Hort. Bot. Hafn. Suppl. 58. 1819; Link, Enum. Pl. Hort. Berol. Edit. Alt. **2**: 15. 1822.

Euphorbia undulata Bernh. ex Hornem. Hort. Bot. Hafn. **2**: 507. 1815; Willd. (Schlecht.) Enum. Pl. Hort. Berol. Suppl. 28. 1813, *nomen nudum*. Non *E. undulata* M. a B. Fl. Taur.-Cauc. **1**: 371. 1808.

Euphorbia pubescens Desf. Fl. Atl. **1**: 386. 1798 (*excl. syn. Vahlii*); Gussone, Syn. Fl. Sic. **1**: 541. 1842, and **2**: 828. 1843; Reich. Ic. Fl. Germ. **5**: *pl. 138, fig. 4769*. 1841; Boiss. in DC. Prodr. **15²**: 134. 1862; Batt. & Trab. Fl. Algér. 795. 1890 (excl. var.); Lojacono-Pojero, Fl. Sic. **2²**: 333. 1904; Jahand. & Maire, Cat. Pl. Maroc **2**: 464. 1932 (saltem p. p.). Non *E. pubescens* Vahl, Symb. Bot. **2**: 55. 1791.

With Jacquin,[12] Gussone, and Lojacono-Pojero I believe that Desfontaines and the authors who have followed him erred in their interpretation of Vahl's *E. pubescens*, the whole trend of the evidence standing against Desfontaines's and Boissier's decisions. The correct binomial for the plant called by these authors *E. pubescens* is *E. crispata* Hornem., so far as I may learn from the literature. It is strange that Vahl's species, not to mention misapplications, should have accumulated not less than four probable synonyms, as follows: (1) *E. vahlii* Jacq. Ecl. **1**: 99. in not. 1813; (2) *E. vahliana* Guss. Syn. Fl. Sic. **2**: 829. in not. 1843; (3) *E. bonae* Mutel, Fl. Franç. **3**: 151. (in not.) 1836; (4) *E. cossoniana* Boiss., in DC. Prodr. **15²**: 135. 1862; Vahl, Mutel, and Boissier practically giving the same descriptions and suggesting the same comparisons with *E. helioscopia* L.

Martínez s. n., Chapultepec, near Mexico City, July, 1940, belongs to *E. crispata* Hornem. (*E. pubescens* auct., non Vahl), and is apparently the first record of this Mediterranean plant as an escape in American floras.

[11] DC. Prodr. **15²**: 6. 1862.
[12] Ecl. **1**: 98–99. pl. 66. 1813.

BOTANY.—*Antagonism and parasitism among some oomycetes associated with root rot.*[1] CHARLES DRECHSLER, Bureau of Plant Industry.

Among the many species of *Pythium* that may be isolated, especially in wet seasons, from softened, discolored, or decaying portions of the roots, stems, or basal leaves of herbaceous cultivated plants, some prove ineffective, under ordinary circumstances, for bringing about the root rot, stem rot, or crown rot with which they were found associated. When these relatively innocuous fungi are not attended by more strongly pathogenic forms, their occurrence in diseased plants is usually held to derive from some limited capacity for parasitism whereby they are enabled to attack phanerogamic hosts that have become much weakened, or in part moribund, as the result of unfavorable external conditions. On the other hand, when, as very often comes to pass, an innocuous species is found accompanied by a demonstrably pathogenic form—or, perhaps, even by two or three such forms—there is reason to presume usually that it entered the plant as a secondary invader, and then propagated itself saprophytically by drawing nourishment from tissues already killed by an earlier invader. However, a more complicated system of biotic relationships would seem to obtain in many cases of root rot where any one of the three echinulate species I described under the names *P. oligandrum*, *P. acanthicum*, and *P. periplocum* (9) is present as secondary invader, since on transparent agar media these species freely display destructive parasitism on many root-rotting forms congeneric with them.

When, for example, *Pythium ultimum* Trow and *P. oligandrum* both grow out from a piece of decaying pea (*Pisum sativum* L.) root into a Petri plate of maizemeal-agar culture medium—as, indeed, has often happened in subjecting diseased pea roots from Maryland, Delaware, New Jersey, and New York, to procedure suitable for isolation of oomycetes—the former is attacked by the latter in spectacular manner. The same parasitic development can be brought to light conveniently by planting the two fungi some distance apart on a maizemeal-agar plate. Along the line where the two growing mycelia meet, the advance of *P. ultimum* is abruptly halted and its hyphae become enveloped in innumerable places by intricately ramifying branches of *P. oligandrum* (Fig. 1). Soon these branches penetrate into the enveloped hyphae and extend prolongations longitudinally within them to assimilate the degenerating protoplasmic contents. Here and there the internal filaments send out ramifications that attack other hyphae of *P. ultimum*. Conidia and young oogonia of *P. ultimum* are also attacked, though apparently with less readiness than young vegetative hyphae. Often the destruction is so rapid and thoroughgoing that in only scattered portions of the *ultimum* mycelium is sexual reproduction permitted to reach a stage where the thick oospore wall affords reliable protection.

Pythium debaryanum Hesse and *P. irregulare* Buism. (3), which occur as casual agents of root rot and damping-off almost as frequently as *P. ultimum*, have likewise been observed undergoing violent attack by *P. oligandrum*, not only in dual cultures prepared purposely for such observation, taking place in the transparent medium merely continues the destruction, but also in isolation plate cultures where manifestly the destruction spontaneously begun in such natural substrata as tomato (*Lycopersicon esculentum* Mill.) roots, pansy (*Viola tricolor* L.) roots, sugar-beet (*Beta vulgaris* L.) seedlings, and peach (*Prunus persica* Sieb. & Zucc.) seedlings. *P. mammillatum* Meurs (13), often found in discolored rootlets of field tomatoes in Maryland and Virginia, is attacked by *P. oligandrum* in dual cultures no less severely than the three familiar damping-off species with which it belongs taxonomically as a member of an intimately interrelated series. In the same series must be included also an apparently undescribed species found occurring abundantly during May, 1939, on pansies seriously affected with root rot in the District

[1] Received July 16, 1942.

of Columbia; the fertilization of its large oogonia, which often measured 28 to 33μ in diameter, by an antheridium consisting frequently of an adjacent hyphal segment, relating it more particularly to *P. ultimum*. This species, too, is very destructively parasitized by *P. oligandrum* in dual cultures, penetration of its hyphae being accomplished after they have been closely enveloped by ramifications of the spiny form (Fig. 2, A). Again, when *P. splendens* Braun, a species less intimately related to those commonly causing damping-off, is grown in dual culture with *P. oligandrum*, it suffers elaborate envelopment of its hyphae, which then are permeated longitudinally by narrow filaments of the spiny form and expropriated of their degenerating contents (Fig. 2, B). *P. salpingophorum* Drechsl. (9) similarly is attacked with spectacular effect, while *P. butleri* Subr., *P. graminicolum* Subr., and *P. arrhenomanes* Drechsl., as also the three interrelated proliferous species I described under the names *P. helicoides*, *P. oedochilum*, and *P. palingenes* (9) suffer less severely in encounters with *P. oligandrum*.

As *Pythium acanthicum* and *P. periplocum* have only occasionally been obtained from softened or discolored roots, isolation plate cultures have afforded little opportunity for observing the behavior of these echinulate species toward the congeneric forms known to cause root troubles. However, when the two species are grown in dual cultures with various congeners pathogenic to phanerogamic plants, parasitic activity similar to that of *P. oligandrum* comes to light: *P. ultimum*, *P. debaryanum*, *P. irregulare*, *P. mammillatum*, *P. splendens*, *P. salpingophorum*, and the *ultimum*-like form found prevalent in pansy roots, being attacked in a most destructive manner, whereas, in general, *P. butleri*, *P. graminicolum*, *P. arrhenomanes*, *P. helicoides*, *P. oedochilum*, and *P. palingenes* incur less ruinous injury. That aquatic congeners are subject to similar adverse action is evident from the readiness with which, in dual cultures, delicate ramifications of *P. acanthicum* (Fig. 2, C, a; D, a) as well as of *P. periplocum* (Fig. 2, E, a) invest the hyphae of *P. marsipium* (Fig. 2, C, b; D, b; E, b), a species I recently described (12) from decaying leaves of the white waterlily, *Nymphaea tuberosa* Paine.

The three species of *Pythium* thus given to attacking other members of the genus are distinguished, even when growing alone, by a delicate mycelial habit achieved through unusually abundant development of slender branches that arise laterally from axial filaments of moderate width. No such copious production of slender branches suitable for envelopment of alien hyphae occurs in the vegetative growth of *P. megalacanthum* de Bary *sensu* Buisman (3), a form associated with flax (*Linum usitatissimum* L.) scorch in The Netherlands, or of the two closely related American species, similarly provided with large oogonia, which I described (9) as *P. mastophorum* and *P. polymastum*. The separateness of the two spiny series, indicated by marked differences both in make-up of sexual apparatus and in mycelial texture, is further evidenced by ready parasitism of the three delicate species on all three of the coarse species. The parasitism of *P. acanthicum* on *P. mastophorum*, initiated by extensive enwrapment of *mastophorum* filaments (Fig. 2, F), has in some instances led to more severe injury than usually eventuates in any of the other eight combinations of host and parasite that are possible between the two series. Since the oogonia of the coarse forms are often invaded even during relatively late stages in their growth, their capacious spiny envelopes often come to surround from three to six alien echinulate oogonia, each usually containing a mature oospore of normal structure.

Pythium anandrum, which I originally described from decaying underground buds of rhubarb (*Rheum rhaponticum* L.) in Maryland (9), and which more recently was also found associated with crown rot of rhubarb in California (14), has its oogonia ornamented with tapering protuberances that in general shape resemble the oogonial spines of *P. oligandrum*, but its mycelium lacks any extensive development of fine ramifications, being rather similar in coarseness and manner of branching to the myce-

lium of *P. debaryanum* or of *P. irregulare*. As might be expected, in view of such similarity, the species is attacked by *P. oligandrum*, though for the most part not with much severity. However, *P. acanthicum* and *P. periplocum* ordinarily show more pro-

Fig. 1.—*Pythium oligandrum* attacking *P. ultimum* in dual culture on maizemeal agar; approximately ×400. Photomicrograph taken by Marguerite S. Wilcox.

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Fig. 1.—*Pythium oligandrum* attacking *P. ultimum* in dual culture on maizemeal agar; approximately ×400. Photomicrograph taken by Marguerite S. Wilcox.

nounced aggressiveness in their attack on *P. anandrum*, many of the hyphae enveloped by them being subsequently invaded and expropriated of contents. *Pythiogeton autossytum*, a pythiaceous fungus that I isolated and described (10) from softened leaf-sheaths of the common cat-tail, *Typha latifolia* L., also is attacked only feebly by *P. oligandrum*, yet suffers appreciable injury when grown in dual culture with either *P. acanthicum* or *P. periplocum*. Wherever a filament of *P. periplocum* (Fig. 2, G, a; H, a) encounters one of *P. autossytum* (Fig. 2, G, b; H, b) it envelops the latter with branches whose somewhat lobate, rounded tips evidently become affixed by means of an adhesive secretion, after the manner of appressoria.

While *Pythium oligandrum* thus is inimical in varying degree to many pythiaceous fungi, it is itself affected unfavorably by a number of oomycetes found associated with root rot. When grown in dual culture with the congeneric *P. complens* Fischer [=*P. gracile* Schenk *sensu* de Bary (1, 2), *P. gracile* (de Bary) *sensu* Ward (16), *P. torulosum* Coker & Patterson (4)], which occurs widely in the decaying roots of numerous phanerogamic plants, including, for example, pansies, peas, sugar beets, beans (*Phaseolus vulgaris* L.), spinach (*Spinacia oleracea* Mill.), and sugar cane (*Saccharum officinarum* L.), a few of its hyphae are attacked and invaded for short distances (Fig. 3, A). It suffers much more severe injury from *Plectospira myriandra* Drechsl., a saprolegniaceous fungus originally isolated from tomato rootlets (7). A growing mycelium of *P. oligandrum* is abruptly halted in its advance wherever it encounters a growing mycelium of *P. myriandra*. Everywhere in the zone of encounter the hyphae of *P. oligandrum* are elaborately enveloped by ramifications put forth from axial filaments of *P. myriandra* (Fig. 3, B). An increased opaqueness of the enveloped hyphae soon announces the onset of progressive disorganization within them. Some of the affected hyphal parts are penetrated and invaded lengthwise, with consequent disappearance of their degenerating protoplasmic materials; though, on the whole, utilization of such materials would seem hardly commensurate with the expenditure entailed in enwrapping the *Pythium* filaments.

Injury from encounter with *Plectospira myriandra* is incurred likewise by *Pythium periplocum* and *Pythium acanthicum*, and in varying measure also by many other congeneric species less intimately related to *Pythium oligandrum*, including those most frequently found responsible for damping-off, root rot, stem rot, and fruit rot. Moreover, destructive behavior toward pythiaceous fungi is not limited to *P. myriandra*, but is displayed with equally telling effect by three root-rotting strains of *Aphanomyces* obtained from infected roots,—two of the strains in question having been isolated from discolored roots of flax and spinach, respectively (11), several years before the third was isolated from softened cortex of a pansy root dug up in Arlington, Va., on May 4, 1939. Judging from the origin and positional relationships of their antheridial branches, the flax and spinach strains appear certainly referable to *A. cladogamus*, a species I based originally on cultures obtained from tomato rootlets (8); and the pansy strain, despite some aberrance, would seem better referable to this species than to any other hitherto described. At all events the three strains, when grown in dual culture with numerous species of *Pythium*, show decided parallelism in their strongly antagonistic behavior. Thus, when the spinach strain encounters the pythiaceous form from decaying waterlily leaves, which, owing to its production of very large globose intramatrical reproductive bodies, appears identical with the form that Dissmann (6) assimilated to *P. undulatum* Pet., it puts forth elaborate ramifications to envelop and destroy the alien hyphae (Fig. 3, C) much after the same manner in which the pansy strain puts forth elaborate ramifications to envelop and destroy hyphae of *P. dissotocum* Drechsl. (Fig. 3, D), a species causing important damage to sugar cane under unfavorable conditions (15).

Less aggressive antagonism is usually displayed by *Aphanomyces cochlioides* Drechsl., a water mold often causing damping-off and root rot of sugar beets in wet fields (8).

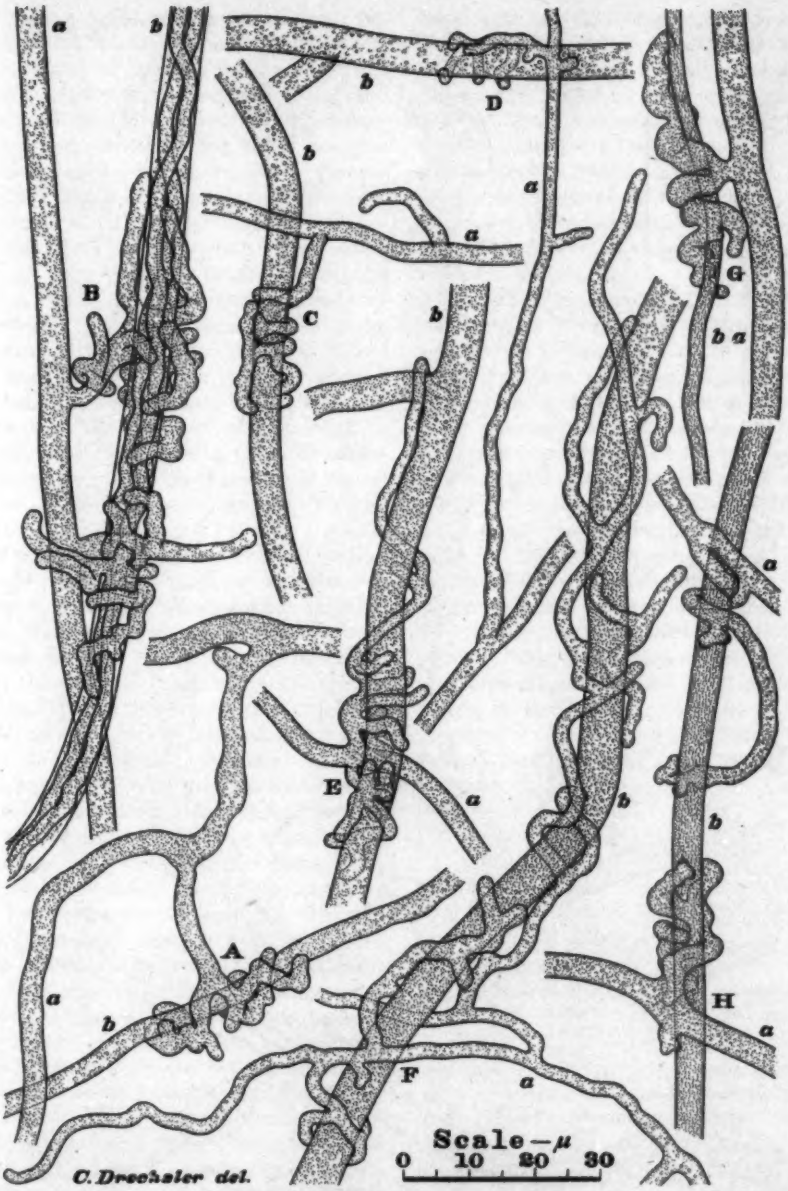

Fig. 2.—Attack of three echinulate species of *Pythium* on several pythiaceous fungi in dual cultures; all parts drawn to a uniform magnification with the aid of a camera lucida; ×1000. A, *Pythium oligandrum*, *a*, enveloping a filament of an *ultimum*-like congeneric species from pansy roots, *b*. B, *P. oligandrum*, *a*, enveloping and invading a filament of *Pythium splendens*, *b*. C, D, *Pythium acanthicum*, *a*, enveloping *Pythium marsipium*, *b*. E, *Pythium periplocum*, *a*, enveloping a filament of *P. marsipium*, *b*. F, *Pythium acanthicum*, *a*, enveloping a filament of *Pythium mastophorum*, *b*. G, H, *Pythium periplocum*, *a*, enveloping *Pythiogeton autossytum*, *b*.

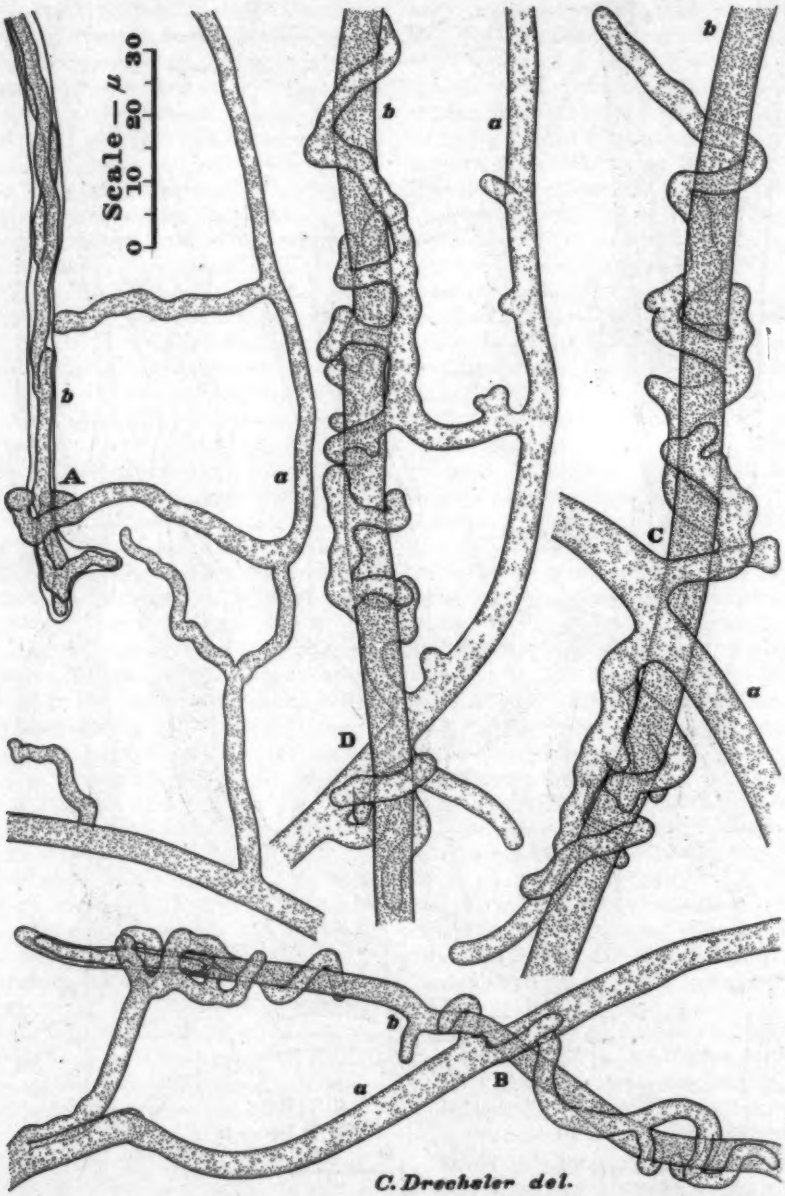

Fig. 3.—Harmful relationships between various oomycetes; all parts drawn to a uniform magnification with the aid of a camera lucida; ×1000. A, *Pythium complens*, *a*, attacking and invading *Pythium oligandrum*, *b*. B, *Plectospira myriandra*, *a*, attacking *P. oligandrum*, *b*. C, Spinach strain of *Aphanomyces cladogamus*, *a*, attacking a filament, *b*, of *Pythium undulatum sensu* Dissmann. D, Pansy strain of *A. cladogamus*, *a*, attacking *Pythium dissotocum*, *b*.

When this saprolegniaceous parasite encounters *Pythium debaryanum* or *P. mammillatum* in dual culture, it abruptly halts the advance of the alien mycelium and causes protoplasmic degeneration in terminal portions of alien hyphae along the zone of encounter; the injury evidently coming about, for the most part, from mere propinquity, since often no special involvement of alien hyphae can be detected. Growing in opposition to *P. myriotylum* Drechsl., which frequently is responsible for field decay of watermelon fruits in Florida, *A. cochlioides* has sometimes been observed extending rangy hyphae to wind loosely about alien filaments here and there, and occasionally has, in addition, been seen putting forth short branches to promote protoplasmic degeneration in these filaments, or even to invade them internally on a small scale.

From their pathogenic behavior under experimental conditions there is reason to believe that both *Aphanomyces cochlioides* and *A. cladogamus* operate mainly as direct parasites on the phanerogamic plants in which they occur habitually. The direct parasitism of *Pythium periplocum* and *P. acanthicum* in causing blossom-end rot of watermelon (*Citrullus vulgaris* Schrad.) fruits could not readily be questioned even if experimental evidence of their infective capabilities were lacking, for when occurring in specimens of this rot the two echinulate species are usually unaccompanied by other likely agents of decay. In the ecological assemblage of oomycetes here under consideration, a capacity for bringing about disease in higher plants can manifestly coexist with a capacity for attacking and injuring other members of the assemblage. However, as the several saprolegniaceous fungi hitherto found attacking higher plants all have smooth oogonia, it appears probable that the spiny *A. exoparasiticus*, described by Couch (5) as being parasitic on various phycomycetes, may not be pathogenic to any species of phanerogams.

The parasitic and antagonistic relationships between oomycetes associated with root rot come into strongest expression where both of the fungi concerned are in a high state of vegetative vigor. In dual cultures that have been started by planting the two species some distance apart hyphal envelopment and hyphal degeneration, if present, is always most pronounced in the narrow zone where the growing mycelia encounter each other, that is, in the zone where, without exception, young vigorous hyphae of the aggressor come upon equally young hyphae of the opposing form. Dual cultures incubated at a temperature of 28°C., which is fairly close to the optimum temperature for mycelial growth in many species of *Pythium*, usually show more extensive hyphal envelopment than similar cultures incubated at 18°C. Hyphal envelopment is usually more abundant when rather soft maizemeal agar, containing 15 grams of agar-agar to the liter, is employed than when the medium used contains 25 grams of agar-agar to the liter. As *Pythium oligandrum*, *P. acanthicum*, and *P. periplocum* initiate and conclude sexual reproduction earlier than most congeneric forms, and as they usually exhaust their mycelia almost completely in producing sexual apparatus, areas in dual cultures first occupied by these species may later be invaded by other species of *Pythium* without much hindrance except, perhaps, from accumulated staling products.

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ZOOLOGY.—*A redescription of* Typhlonema salomonis *Kreis (Nematoda).*[1]

JOHN T. LUCKER, Bureau of Animal Industry.

Male and female specimens of a nematode from the digestive tract of skinks of the genus *Mabuya,* collected in 1939 in Belgian Congo by Arthur Loveridge, of the Museum of Comparative Zoology, Harvard University, are believed by the writer to represent *Typhlonema salomonis* Kreis, 1938. This genotype was based on female characters, and partly because of this the systematic position of the genus *Typhlonema* has been regarded as uncertain.

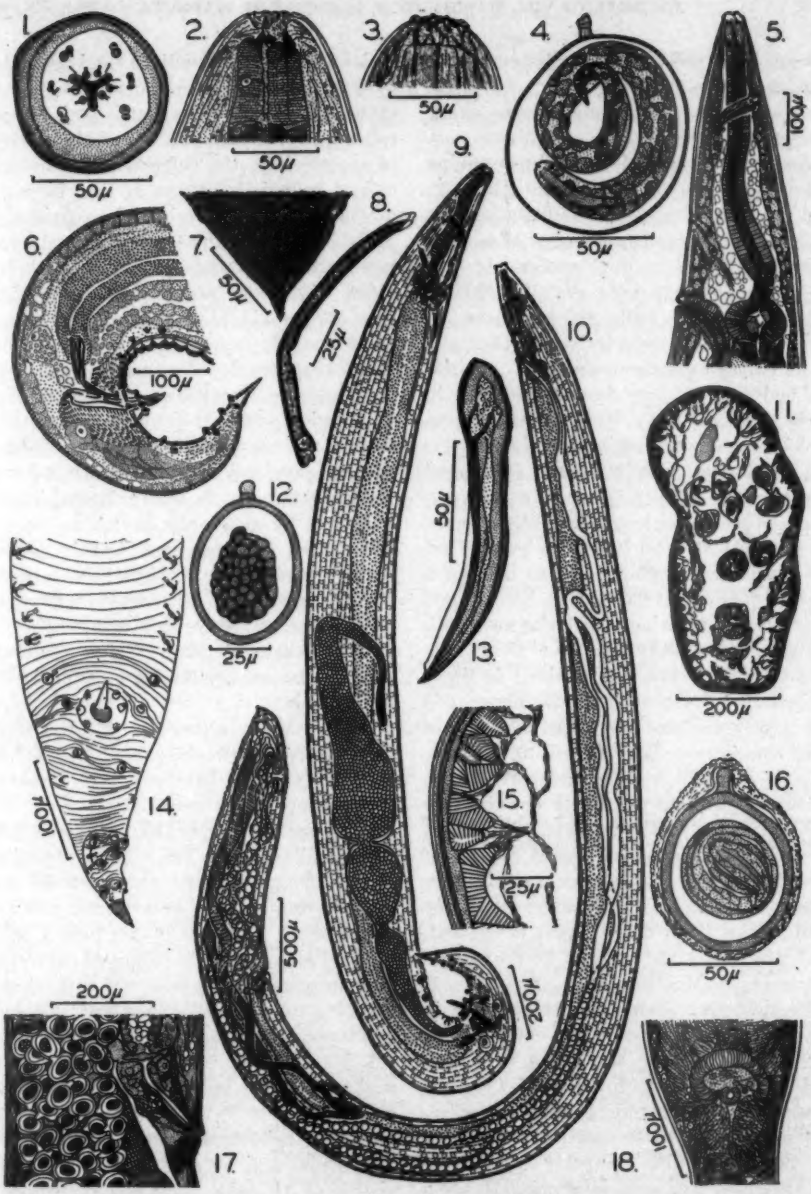
The available specimens are not from the type host or locality of Kreis's species. The writer's identification of them, therefore, is based entirely on morphological grounds. It should be emphasized, however, that there are certain discrepancies between the morphology of the females, as determined by the writer, and the characteristics ascribed to *T. salomonis* by Kreis.[2] The African specimens have an anus, weakly developed, but distinct, equal lips and the typical ascaridoid complement of cephalic papillae. In view of well-established facts concerning the structure of ascaridin nematodes generally, it seems very likely, however, that a reexamination of Kreis's specimens, if undertaken, will show that they also have an anus and the usual number, as well as a normal distribution, of cephalic papillae. Hence, because the available females agree with Kreis's description in the important points of vulva position and structure of eggs, both of which are unusual, as well as in many other details, the writer has no hesitancy in regarding them as belonging to the genus *Typhlonema.* Also, there appears to be no acceptable evidence and little chance that the specimens from *Mabuya* differ specifically from Kreis's specimens from *Gecko.* Therefore, there is here presented, as a recharacterization of *T. salomonis,* the following description of the female and male specimens from Africa in an effort to delineate more satisfactorily the characteristics and affinities of *Typhlonema.*

[1] Received September 29, 1942.

[2] KREIS, HANS A., *Beiträge zur Kenntnis parasitischer Nematoden. VIII. Neue parasitische Nematoden aus dem Naturhistorischen Museum Basel.* Zentralbl. Bakteriol., 1 Abt. Orig., **142** (5–6): 329–352. 1938.

Typhlonema salomonis Kreis, 1938

Description.—Lips flat, weakly developed; each probably corresponding to apical portion only of typical ascaridoid lip. Cephalic papillae of internal circle very prominent; amphids and the four double papillae of external circle well developed; ventrolaterals present, but small and rather weakly developed (Figs. 1, 3). Oral opening roughly triangular; stoma small, apparently consisting of sclerotized protorhabdions partly surrounded by esophageal tissue (Fig. 2). Esophagus with short, histologically differentiated vestibule (Figs. 2, 5); corpus



Figs. 1–18.—*Typhlonema salomonis*: 1, Head (female), *en face* aspect. 2, Anterior extremity (female), optical section through protorhabdions and vestibule, slightly oblique dorsal aspect. 3, Cephalic region (female), showing papillae of dorsal lip, superficial dorsal aspect. 4, Egg from anterior portion of uterus, embryonated but lacking protein coat, optical section. 5, Female, esophageal region, lateral aspect. 6, Male, caudal region, lateral aspect. 7, Female, tip of tail, lateral aspect. 8, Spicule (left), lateral aspect. 9, Male, lateral aspect. 10, Female, lateral aspect. 11, Cross section (female) slightly anterior to anus, showing musculature. 12, Egg from posterior portion of uterus, in cleavage stage, optical section. 13, Gubernaculum, lateral aspect. 14, Male, caudal region, ventral aspect. 15, Portion of cross section (female), showing muscle cells. 16, Egg from ovijector, embryonated and with fully developed protein coat, optical section. 17, Female, anal region, lateral aspect. 18, Male, optical section through cloacal region, showing appearance of muscles slightly beneath ventral surface.

highly muscular, proportionately long, slender, of almost uniform diameter except for slight swelling in postcorpal region; isthmus short, but definite, of lesser diameter than postcorpus; bulb ovoid, well developed, containing well developed valvular apparatus (Fig. 5). Deiriids apparently absent. Excretory pore at level between bulb and postcorpus of esophagus; terminal excretory duct moderately long (Fig. 5). Lateral alae, narrow, distally bifid, extending from near cephalic region to near cloacal region in male; absent in female. Musculature, polymyarian-platymyarian in anterior part of body and polymyarian-coelomyarian in midbody (Figs. 11, 15). Body laterally compressed in some fixed specimens (Fig. 11), except in esophageal region, but nearly cylindrical in others.

Female.—Maximum length in available specimens about 16.85 mm; length in young, but gravid specimens ranging down to about 8.5 mm. Body of more or less uniform diameter except for gradual tapering in anterior one-tenth to cephalic extremity (diameter about 40–50μ) and sudden tapering posteriorly to tip of tail. Maximum dorsoventral width about 0.59 mm in large specimens and about 0.30 mm in smallest specimens. Anus (Figs. 10, 17) unusually far removed from posterior extremity. Tail long, equivalent to about one-sixth to one-fifth of body length; diameter throughout most of its length almost as great as that of midbody; tapering in its extreme posterior portion only and terminating in a small acutely pointed process (Figs. 7, 10). Vulva prominent, located alongside bulb, isthmus, or postcorpus of esophagus, behind excretory pore (Figs. 5, 10). Reproductive system opisthodelphic; in young specimens the moderately long vagina passes posteriorly from the vulva to a long ovijector which unites with two slender parallel uteri which extend posteriorly into the tail region, sometimes nearly to posterior tip of body where they unite with oviducts; oviducts reflexed anteriorly and somewhat coiled, leading to ovaries which pass anteriad and parallel to region just anterior to anus where their tips are reflexed posteriorly (Fig. 10). In fully grown specimens the uteri are somewhat distended and coiled, particularly in caudal region, sometimes entwined about intestine and sometimes also coiled anteriorly and extending almost to region of esophageal bulb so fundamental plan of reproductive system is obscured. Ovoviviparous; uterine eggs of eccentric oval to spherical shape, provided with monopolar knob, and of roseate hue, the coloration apparently localized in perivitellus space. Eggs in posterior portions of uteri in various cleavage stages, of variable size, tending to be distorted by pressure, with moderately thick, dense shell provided with monopolar thumb-like projection (Fig. 12); in middle portions of uteri some eggs embryonated, frequently with shell thinner than in less developed or mature eggs and also tending to be larger than these eggs (Fig. 4); in anterior portions of uteri, in oviduct and vagina, the eggs are larvated, almost spherical and are provided with well-developed rugose, mammillated protein coat anchored in part to true shell by monopolar thumblike process of latter and forming around this process a bluntly rounded knob (Fig. 16), the true shell being thicker than in uncoated embryonated eggs, apparently as result of compression. Fully developed eggs are about 60μ to 87μ long, including the monopolar knob, and about 50μ to 60μ wide.

Male.—Much shorter and comparatively more robust than female; about 3.1 mm long by about 0.24 mm in maximum dorsoventral width; esophagus about 0.37 mm long. Reproductive system simple (Fig. 9); testis reflexed near middle of body. Tail subulate, terminating in an extremely minute spike, curved sharply ventrad and anteriad in available fixed specimens; about 0.22 to 0.24 mm long. Cuticle in region just anterior to cloaca thrown up into prominent transverse folds not appearing to be homologous with mamelons and not bearing plectanes, appearing to be provided with close-set longitudinal intrastrial ridges. Preanal sucker absent, but circumcloacal elevation present (Figs. 6, 9, 14); arrangement of musculature in pericloacal region as shown in figure 18; caudal alae absent. Caudal papillae consisting of 16 pairs, including 5 preanal sublateral pairs and 11 pairs distributed as follows: 4 subventral pairs in the circumcloacal or adanal position, 3 of them on the circumcloacal elevation and 1 lateral to it; 7 definitely postanal pairs, 4 of them subventral (first, third, fifth and seventh pairs from the caudal tip) and 3 sublateral (second, fourth and sixth pairs

from caudal tip; Fig. 6). The posteriormost pair on the circumcloacal elevation is weakly developed (Fig. 14). Five pairs of the postanals are grouped near the caudal tip; the two sublateral pairs in this group are smaller than the three subventral pairs (Fig. 14). Gubernaculum cuneiform, very prominent, robust, strongly sclerotized, alate, about 0.143 mm long; provided with a proximal pair of triangular latero-ventrally directed wings; distal tip usually protruding from cloacal opening and rather sharply pointed (Figs. 6, 9, 13, 14). Spicules two, elongate, very slender, about 0.130 mm long, lightly sclerotized, slightly expanded proximally, with bluntly pointed alate hyaline distal tip (Figs. 6, 8, 9).

Hosts.—*Gecko vittatus* Houtt. (type host); *Mabuya striata* (Peters); *Mabuya megalura* (Peters).

Location.—Stomach and intestine.

Distribution.—Makira, Solomon Islands; Molinga River, Idjwi Islands, Belgian Congo.

Specimens.—U.S.N.M. Helm. Coll. nos. 40695; 40698; 45308. (Specimens also in Museum of Comparative Zoology, Harvard Univ.)

Remarks: Kreis[3] placed *Typhlonema* in the Oxyuroidea and in the subfamily Oxyurinae. Walton,[3] in a key to some oxyuroid genera from reptiles, tentatively included the genus under the Oxyuridae, remarking on the difficulty of placing it systematically and stating that it shows affinities to both Atractidae and Oxyuridae. On the basis of the foregoing description, it is the writer's opinion that *Typhlonema* belongs in the Ascaridoidea, as conceived by Chitwood and Chitwood,[4] and in the family Cosmocercidae. Although the musculature in *Typhlonema* is polymyarian, whereas the family Cosmocercidae is characterized by authors as meromyarian, in other respects the genus appears to be far more closely related to certain cosmocercid genera than to any belonging in the four other ascaridoid families recognized by the Chitwoods.

[3] WALTON, A. C. *Some oxyurids from a Galapagos turtle.* Proc. Helm. Soc. Washington 9(1): 1–17. 1942.

[4] CHITWOOD, B. G., and CHITWOOD, M. B., *An introduction to nematology*, sect. 1, pt. 1, 53 pp. 1937.

PROCEEDINGS OF THE ACADEMY

378TH MEETING OF THE BOARD OF MANAGERS

The 378th meeting of the Board of Managers was held in the library of the Cosmos Club on November 16, 1942. President CURTIS called the meeting to order at 8:01 P.M., with 17 persons present, as follows: H. L. CURTIS, F. D. ROSSINI, R. J. SEEGER, J. E. GRAF, F. H. H. ROBERTS, Jr., F. G. BRICKWEDDE, F. C. KRACEK, W. G. BROMBACHER, F. M. SETZLER, H. L. HALLER, A. WETMORE, F. B. SILSBEE, E. W. PRICE, L. W. PARR, H. G. DORSEY, and, by invitation, G. A. COOPER and A. SEIDELL.

The minutes of the 377th meeting were read and approved.

President CURTIS announced the appointment of F. B. SILSBEE (chairman), J. E. GRAF, and C. L. GARNER to constitute a special committee to consider recommendations for increasing the income of the Academy.

For the committee to consider ways and means of decreasing the expenses of the Academy, Chairman BRICKWEDDE presented a complete and detailed report embodying a number of recommendations. In acting upon this report, the Board authorized the appointment of a special committee to consider a change in the number of issues of the JOURNAL from 12 monthly to 6 bimonthly issues a year without decreasing the total number of pages or the amount of material published each year, and also to consider a change in the kind of printing of the JOURNAL from the present typeset printing to a photographic offset process. Suggestions regarding certain other possible economies were referred to the 1943 Executive Committee.

For the committee to consider recommendations for increasing the income of the Academy, Chairman SILSBEE presented a complete and detailed report. As a result of the suggestions made, the Board authorized the appointment of a committee to contact the U. S. Office of Coordinator of Inter-American Affairs with regard to the purchase by them of subscriptions to the Academy's JOURNAL for transmission to the more important libraries in South America.

The Secretary reported the deaths of two members.

Senior Editor SEEGER reported that the December number of the JOURNAL might need to be sharply curtailed to insure keeping within the 1942 allotment. The Board authorized the Editors to expend, if necessary, up to $65

beyond their 1942 allotment to prevent curtailing the December number of the JOURNAL unduly. The extra allotment thus provided is the amount of estimated balances unexpended from other items in the 1942 budget of the Academy.

The changes in the Standing Rules of the Board, proposed at its previous meeting, were approved, as follows:

(1) Under the present Rule 3, delete the present version and substitute the following: "There shall be four standing committees, as follows: Executive Committee, Committee on Meetings, Committee on Membership, and Committee on Monographs. Two members of the Board shall be appointed to serve on the Executive Committee. The Committee on Membership shall include at least three persons reappointed from the preceding year. All appointments shall be for one year unless otherwise specified, and shall be made by the President, who shall announce them at the first meeting of the Board following the annual meeting."

(2) Under the present Rule 8, delete the second sentence.

(3) Between the present Rules 6 and 7, insert the following new Rule: "Associate Editors of the JOURNAL shall be appointed by the President for a term of three years."

The Board instructed the Custodian and Subscription Manager of Publications, W. W. DIEHL, to provide the Board with information on the list of free subscriptions to the JOURNAL and on the number and distribution of Government subscriptions.

The meeting adjourned at 10:38 p.m.

314TH MEETING OF THE ACADEMY

The 314th meeting of the Academy was held jointly with the Philosophical Society of Washington in the Assembly Hall of the Cosmos Club at 8:15 P.M. on November 19, 1942, with President CURTIS presiding. W. G. BROMBACHER introduced the speaker.

DEANE B. JUDD, physicist in the section on photometry and colorimetry at the National Bureau of Standards, delivered an address on *Color blindness and its relation to the detection of camouflage*. Dr. JUDD indicated the requirements for camouflaging ground positions correctly, showed which of these requirements can be met in a practical way, and described under what conditions color-blind observers can spot certain camouflaged positions.

There were about 135 persons present.

FREDERICK D. ROSSINI, *Secretary*.

Obituary

ALFRED N. FINN, chief of the glass section, National Bureau of Standards, died on September 21, 1942, at Lincoln, Nebr. He had been in ill health for the past year and had retired from active work.

Mr. Finn was born in Denver, Colo., in 1882. He received his A.B. degree in 1906 and his M.A. in 1909 from the University of Denver. After several years as an instructor at the University of Denver he was appointed in 1911 as an assistant chemist at the National Bureau of Standards. His work dealt with cements, paints and oils, boiler waters and boiler compounds, protective coatings for metals, and corrosion of ferrous and nonferrous alloys. In 1919 he accepted a position as chief chemist and metallurgist for the Hydraulic Steel Co., Cleveland, Ohio, but later returned to the Bureau as chief of the glass section.

Mr. Finn was an authority on glass technology and had charge of the Bureau's production of optical glass. He also directed the making of a glass disk 70 inches in diameter and 11 inches thick for use as a reflector in an astronomical telescope now in use at the Ohio Wesleyan University. He had been a member of the following organizations: Washington Academy of Sciences, American Chemical Society, American Ceramic Society, American Society for Testing Materials, Optical Society of America, and American Institute of Chemists.

P. H. BATES.